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# *Biographical notices of mineralogists recently deceased. (Eighth series.)*

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[Read November 6, 1947.]

OBITUARY notices of mineralogists appeared distributed through the pages of this Magazine from its commencement in 1876 until 1919. After the disruption caused by the first world war (1914–18) it was felt that these would be more convenient for reference if collected together in each volume. Nos. 1–7 of this series[1] appeared regularly every three years in vols. 19–25 (1921–39). Since 1939 they have been held in abeyance owing to the disruption caused by the second world war (1939–45) and the restrictions on the use of paper. The present accumulation of 87 notices covers the period 1939–47. Ages range from 26 to 90 with an average of 68·9 years. As shown in the following table, the steady increase in the average age has now been checked.

| Series. | Period. | Min. Mag. vol. | No. of lives. | Total years lived. | Average age. |
|---|---|---|---|---|---|
| — | 1876–1919 | 1–18 | 210 | 13,271 | 63·2 years |
| I | 1919–21 | 19 | 43 | 2,738 | 63·6 |
| II | 1921–24 | 20 | 49 | 3,317 | 67·7 |
| III | 1924–27 | 21 | 42 | 2,858 | 68·0 |
| IV | 1927–30 | 22 | 39 | 2,660 | 68·2 |
| V | 1930–33 | 23 | 41 | 2,899 | 70·7 |
| VI | 1933–36 | 24 | 36 | 2,556 | 71·0 |
| VII | 1936–39 | 25 | 30 | 2,180 | 72·7 |
| VIII | 1939–47 | 28 | 87 | 5,995 | 68·9 |
| | | | 577 | 38,474 | 66·7 |

[1] Indexes to notices are given in vol. 19, pp. 259–262, and vol. 23, pp. 364–366. A mortality curve is given in vol. 20, p. 253.

Adams (Frank Dawson) [1859–1942], Emeritus Professor of Geology and Vice-Principal of McGill University, Montreal. He was born in Montreal on September 17, 1859, and died there on December 26, 1942. After graduating at McGill he was a research student at Yale University where he made several chemical analyses of scapolites and was the first, in 1879, to recognize that chlorine is an essential constituent. Later he worked with H. Rosenbusch at Heidelberg. In 1880 he was appointed assistant chemist and later petrographer on the Geological Survey of Canada, resigning in 1889 to be lecturer in geology at McGill and becoming professor in 1893. He did much work on the ancient crystalline rocks of the Canadian shield. In 1894 large outcrops of nepheline-syenite were discovered in the Bancroft area with deposits of corundum and ornamental blue sodalite of economic value. From these rocks in Hastings County hastingsite was described as a new alkali-hornblende. Much later (1932) he described nepheline-syenites from Northern Rhodesia. Pioneer work was done in experimental geology in observing the effect on materials under different conditions of pressure, temperature, and solution, each condition being investigated separately and then in combination. The elastic constants and compressibility of rocks were determined; and the transfusion of matter from one solid to another under the influence of heat was studied in relation to metamorphism. Under high pressure marble was made to flow with gliding and twinning of the calcite grains; and the deformation of various minerals and rocks was recorded. After his retirement from McGill he visited in 1926–27 Ceylon, Burma, and Malaya, producing the first geological map of Ceylon and giving good accounts of the gemstone, graphite, and tin mines. In 1938 he published a most interesting and scholarly book 'The birth and development of the geological sciences' digested from over a thousand old volumes of the early literature in his own library. He was president of the 12th International Geological Congress in 1913 at Toronto, of the Royal Society of Canada (1913), and of the Geological Society of America (1917). He was elected F.R.S. in 1907, and was awarded the Lyell and Wollaston medals of the Geological Society of London.

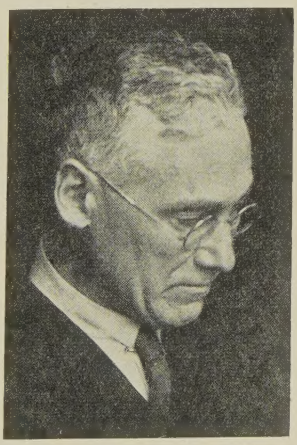
C. E. Tilley, Nature, London, 1943, vol. 151, pp. 102–103. H. M. Tory, Science, New York, 1943, vol. 97, pp. 235–236; Trans. Roy. Soc. Canada, 1943, ser. 3, vol. 37, Proc. pp. 69–71, with portrait. R. T. Chamberlin, Journ. Geol. Chicago, 1943, vol. 51, p. 212. J. S. Flett, Obituary Notices of Fellows of the Royal Society, 1943, vol. 4, pp. 381–393, with portrait and bibliography. H. H. R[ead], Quart. Journ. Geol. Soc. London, 1944, vol. 99 (for 1943), pp. lxxix–lxxxi. H. Dale, Proc. Roy. Soc. London, Sect. A, 1944, vol. 182, p. 218; Sect. B, 1944, vol. 132, p. 2.

J. A. Dresser, Proc. Geol. Soc. Amer., 1946, for 1945, pp. 143–151, with portrait and bibliography.

Aloisi (Piero) [1881–1938], Professor of Mineralogy in the University of Firenze (Florence), was born at Livorno (Leghorn) on May 19, 1881, and died at Firenze on September 2, 1938. He studied at the University of Pisa and was assistant there under G. D'Achiardi. In 1924 he was appointed extraordinary professor of mineralogy in the University of Firenze and ordinary professor in 1927, in which post he was succeeded by G. Carobbi. Since 1904 he had written several petrographical papers on Italian and Eritrean rocks, and on various Italian minerals with detailed crystallographic descriptions. A large volume (1933) describes the rocks collected by the Filippi expedition of 1913–14 to the Himalaya, Karakorum, and Chinese Turkestan, and he also wrote a large and attractive book on precious stones 'Le gemme' (1932).

G. D'Achiardi, Atti (Proc. Verb.) Soc. Toscana Sci. Nat., 1938, vol. 47, pp. 58–63; Atti (Rend.) R. Accad. Lincei, Roma, Cl. Sci. fis. mat. nat., 1939, ser. 6, vol. 29, pp. 95–102, with bibliography. G. Carobbi, Boll. Soc. Geol. Ital., 1939, vol. 58, pp. lxxxii–xcv.

Aminoff (Gregori) [1883–1947], Swedish mineralogist and a member of our Society since 1931, was born at Stockholm on February 8, 1883, and died suddenly of heart disease on February 11, 1947. His ancestors were a Russian boyar family who settled in Sweden in 1612. After studying science at Stockholm and graduating at Upsala in 1905, he turned artist, studying in France and Italy, and he did not return to scientific work until 1914. In 1918 he was docent in mineralogy and crystallography in the University (Högskola) of Stockholm, and in 1923 succeeded Hjalmar Sjögren (1856–1922) as head of the mineralogical department of the State Natural History Museum (Riksmuseum) with the title of professor. A bibliography of his published papers extends to 78 items (62 of which have been noticed in 'Mineralogical Abstracts'). His first paper in 1904 was on the Elfdalen porphyry followed in 1906 by one on the crystallography of some organic compounds. Then there was



G. AMINOFF (in 1933)

a gap of several years, while he was an artist, followed from 1916 by a series of papers descriptive of Swedish minerals, mostly from Långban. Eleven new minerals (including bromellite, BeO) were established with data determined by all available methods on chemically analysed material, and the results were stated very clearly and concisely. 'These excellent papers may well be taken as a pattern' (Ann. Rep. Chem. Soc., 1928, vol. 24 (for 1927), p. 302). He was the first in Sweden, in 1918, to apply X-ray methods in the examination of minerals, and later he developed the X-ray spectrographic method for the determination of traces of chemical elements. Some of his later papers were in collaboration with his wife under the name B. Broomé.

S. Gavelin, Geol. För. Förh. Stockholm, 1947, vol. 69, pp. 253–254. G. Hägg, Nature, London, 1947, vol. 159, p. 597.

Andersen (Olaf) [1884–1941] was born at Hönefoss, Norway, on March 12, 1884, and died at Millington, New Jersey, on July 18, 1941. He graduated at Oslo in 1903 and was assistant there to W. C. Brøgger. In 1911 he went to Columbia University in New York City, and in 1912–18 was petrologist in the Geophysical Laboratory of the Carnegie Institution of Washington. Returning to Norway (1918–28) an attempt was made to establish a geophysical laboratory in connexion with the Geological Survey, and some work was done on silicate melts and on the felspars. He had previously described aventurine felspars [M.A. 1–392]. In 1928 he went again to America and worked with R. B. Sosman on refractory materials in the research laboratory of the United States Steel Corporation at Kearny, New Jersey, and also taught geology and petrology in the Stevens Institute of Technology at Hoboken, New Jersey.

R. B. Sosman, Amer. Min., 1942, vol. 27, pp. 192–195, with portrait and bibliography. A. Bugge, Norsk Geol. Tidsskrift, 1942, vol. 21 (for 1941), pp. 239–244, with bibliography.

Anderson (Charles) [1876–1944], Australian mineralogist, was born at Stenness, Orkney Islands, on December 5, 1876, and died at Sydney, New South Wales, on October 25, 1944. After graduating at Edinburgh University, where he gained medals for mineralogy, crystallography, geology, chemistry, physics, and zoology, he worked for a time at the Ben Nevis Observatory, and in 1901 was appointed mineralogist in the Australian Museum at Sydney, becoming director of the museum in 1921 and retiring in 1940. His papers on Australian minerals, usually

entitled 'Mineralogical notes' (nos. I–XI, 1904–22), were mainly crystallographic with excellent drawings of crystals. His 'Bibliography of Australian mineralogy' (1916) contains useful indexes of minerals and of localities for each State of the Commonwealth. He also gave 'A catalogue and bibliography of Australian meteorites' (1913) and described the Binda meteorite. Since his appointment as director of the museum he had given his attention to vertebrate palaeontology. He was president of the Royal Society of New South Wales in 1924 and editorial secretary in 1935–43.

T. Hodge Smith, Australian Journ. Sci., 1944, vol. 7, pp. 87–88. Rec. Australian Mus., 1945, vol. 21, pp. 279–282, with portrait.

Bayley (William Shirley) [1861–1943], Emeritus Professor of Geology in the University of Illinois at Urbana, was born at Baltimore, Maryland, on November 10, 1861, and died on February 14, 1943. He graduated at Johns Hopkins University, and for some years was professor of geology in Colby College at Waterville, Maine, and in Lehigh University at South Bethlehem, Pennsylvania. In 1906 he was assistant professor of mineralogy and economic geology in the University of Illinois, professor of geology in 1913, and head of the department in 1928, retiring in 1931. From 1885 to 1931 he was also on the staff of the United States Geological Survey and produced monographs on the rocks and iron ores of the Lake Superior region. He wrote text-books 'Elementary crystallography' (1910), 'Minerals and rocks' (1916), and 'Descriptive mineralogy' (1916). During several years he supplied abstracts in the Neues Jahrbuch für Mineralogie. He was president in 1936 of the Mineralogical Society of America.

M. M. Leighton, Science, New York, 1943, vol. 98, pp. 145–146; Proc. Geol. Soc. Amer., 1944, for 1943, pp. 105–115, with portrait and bibliography. C. S. Ross, Amer. Min., 1944, vol. 29, pp. 115–120, with portrait and bibliography.

Bemrose (Henry Howe) [1857–1939], Derbyshire geologist, was born at Derby on March 13, 1857, and died there on July 17, 1939. To distinguish between himself and his father, Sir Henry Howe Bemrose [1827–1911], he early assumed the name of Arnold-Bemrose, reverting to Bemrose on the death of his father. Most of his geological papers appeared under the name H. H. Arnold-Bemrose. A mathematical scholar of Clare College, Cambridge, he was placed in the tripos in 1879. He then entered the printing firm of Bemrose and Sons in which he took an active part for over fifty years. (J. J. H. Teall's 'British petrography',

1888, with its many coloured plates, was printed by this firm.) He was Mayor of Derby in 1909, and was prominent in educational and other public affairs. His interest in geology and microscopic petrography was aroused by J. J. H. Teall who had given Cambridge University extension lectures in Derby in 1880. He gave excellent accounts of the toadstones (dolerites and tuffs) of Derbyshire, describing olivine nodules and pseudomorphs after olivine. The development of quartz crystals in the Carboniferous Limestone was recorded. He joined the Geological Society in 1886 and was awarded the Murchison Medal in 1938. The Cambridge degree of Sc.D. was taken in 1908. He had been a member of the Mineralogical Society since 1886 and was the second senior member, predeceasing A. Harker by only a few days.

Proc. Geol. Assoc. London, 1940, vol. 51, pp. 109–110. W. A. R[ichardson], Quart. Journ. Geol. Soc. London, 1945, vol. 100 (for 1944), pp. lxiv–lxv.

Bergt (Walther Adolf) [1864–1941] was born at Burgstädt in Saxony and died on February 28, 1941. He studied at Leipzig and Heidelberg and for some years was a school-teacher in Dresden. In 1898 he became assistant in the Mineralogical and Geological Museum of the Dresden Zwinger, and later also assistant to E. Kalkowsky in the Mineralogical Institute of the Technical High School in Dresden, becoming extraordinary professor in 1900. In 1906 he took charge of the geological collections in the Grassi Museum in Leipzig, with the object of completing the description of the South American material collected by A. Stübel. During this period he was also docent (1910–37) in mineralogy and petrology in the University of Leipzig. His doctor dissertation in 1888 was on rocks from Colombia; and other material collected by Stübel in Peru, Dutch Guiana, San Domingo, Madeira, Cape Verde Islands, &c., was described later. He also described many rocks and some minerals from Saxony.

K. H. Scheumann, Min. Petr. Mitt. (Tschermak), 1941, vol. 53, pp. 155–157, with bibliography.

Berkeley (Randal Thomas Mowbray Rawdon) [1865–1942], eighth and last Earl of Berkeley, was born in Brussels on January 31, 1865, and died at Berkeley Castle in Gloucestershire on January 15, 1942. After resigning from the Royal Navy he studied chemistry and geology in the Royal College of Science at South Kensington, being especially interested in the relation between crystal-structure and chemical composition. Later he moved to Oxford where he was one of the first pupils

of H. A. Miers, and he built a small research laboratory at his home on Boars Hill. His work on physical chemistry, mostly on osmotic pressure, was done in collaboration with E. G. J. Hartley and others. He was a member of our Society from 1894 to 1908, and his first paper 'On an accurate method of determining the densities of solids' was published in this Magazine in 1895.

W. C. D. Dampier, Nature, London, 1942, vol. 149, p. 163. H. Hartley, Obituary Notices of Fellows of the Royal Society, 1942, vol. 4, pp. 167–182, with portrait and bibliography; Journ. Chem. Soc., 1943, pp. 503–507.

Berman (Harry) [1902–44], American mineralogist, was born on February 16, 1902, at Boston in Massachusetts and met an untimely end in an aeroplane crash on August 27, 1944, at Prestwick in Scotland. After a school education he started an engineering training in the Carnegie Institute of Technology at Pittsburgh, but owing to financial difficulties this was abandoned, and in 1922 he obtained a post in the mineralogical section of the United States National Museum at Washington, D.C. In 1924 he went to Harvard University as assistant in the mineralogical museum, where at the same time he continued his studies and took the Ph.D. degree in 1936. In 1932–33 he had also studied in Europe at Göttingen, Heidelberg, and Cambridge. In 1940 he was appointed associate professor of mineralogy and curator of the mineralogical museum at Harvard University. His first paper in 1935 was followed by 36 others, usually in collaboration with other authors, in which no less than 17 new minerals or new names were described. He installed the first X-ray equipment in the mineralogical department at Harvard, devised a microbalance for determining the specific gravity of small pure fragments of minerals, and collaborated in the second edition of E. S. Larsen's 'Microscopic determination of the nonopaque minerals' (1934). Since 1936 he did intensive work on the seventh edition of Dana's 'System of mineralogy', being mainly responsible for the final writing up from the accumulation of notes, the first volume of which appeared only shortly before his death. On the outbreak of

H. BERMAN (in 1944)

war he turned his attention to the production of optical calcite and fluorite, and afterwards to the working of piezoelectric quartz. It was while travelling in connexion with the last that a promising career was unfortunately terminated in the prime of life. A Berman Memorial X-ray Laboratory was dedicated in the Department of Mineralogy and Petrography, Harvard University, on November 1, 1946.

Rocks and Minerals, Peekskill, N.Y., 1944, vol. 19, pp. 312, 388; 1945, vol. 20, p. 50. C. Palache, Econ. Geol., 1944, vol. 39, pp. 523–525. C. S. Hurlbut, Jr., Amer. Min., 1945, vol. 30, pp. 124–129, with portrait and bibliography. E. S. Larsen, Proc. Geol. Soc. Amer., 1945, for 1944, pp. 151–154, with portrait and bibliography; Mineração e Metalurgia, Rio de Janeiro, 1945, vol. 10, pp. 21–22, with portrait and bibliography.

Billiet (Valère Louis) [1903–45], Belgian mineralogist, was born at Ghent (Gand) on February 14, 1903, and was shot by the Germans when the ship 'Cap Arcone' was bombed by aircraft in Lübeck bay a few days before the end of the war in May 1945. As a prominent member of the resistance movement, he had been taken prisoner in August 1944. In 1923 he was assistant and later 'chef de travaux' in mineralogy and crystallography in the University of Ghent. Since 1926 he had published many papers, some on Belgian minerals including clays, but mostly on secondary uranium minerals and copper and cobalt hydroxides from Katanga, which were examined by optical and X-ray methods. Billietite, a hydrated uranate of barium from Katanga, was named in his memory in 1947.

V. van Straelen, Bull. Soc. Belge Géol. Bruxelles, 1945, vol. 54, pp. 140–141. A. Hacquaert, Natural sciences in Belgium during the war, Ghent, 1946, p. 106, with portrait. J. F. Vaes, Ann. (Bull.) Soc. Géol. Belgique, Liége, 1947, vol. 70, p. B 212.

Blake (George Stanfield) [1876–1940], formerly Government Geologist in Palestine, was murdered by Arab bandits on July 4, 1940, while prospecting for oil near Sodom. After studying (1893–96) at the Royal School of Mines in London he was an assayer in London and Elba. In 1901–9 he was on the staff of the scientific and technical department of the Imperial Institute in charge of mineral analysis mainly of materials sent in by the mineralogical surveys of the Colonies. Then he went exploring for minerals in Matto Grosso, Brazil, and prospecting for oil in Newfoundland and Canada, returning to England in 1915 for analytical work on munitions. In 1921–22 he was on the

staff of the Geology Department of the Imperial College of Science and Technology, and in 1922 was appointed geological adviser to the Government of Palestine, retiring in 1939 to take up consulting work. With W. R. Dunstan thorianite from Ceylon was described as a new mineral in 1905. He was a member of our Society since 1906 and three joint papers on baddeleyite and zirkelite from Ceylon and carnotite from South Australia appeared in this Magazine. These few papers represented work done in the Imperial Institute: the results of other work are recorded in the annual volumes for 1904–10 of 'Geological literature' issued by the Geological Society, although in the original publications the author's name does not appear. He produced a geological map of Palestine and reports on the mineral resources of Palestine and Transjordan, and was largely responsible for developing the process of extracting potash from the Dead Sea brines.

Bull. Imp. Inst. London, 1940, vol. 38, pp. 365–366. Trans. Inst. Mining & Metall., 1941, vol. 50 (for 1940–41), pp. 540–541. A. B. T[hompson], Quart. Journ. Geol. Soc. London, 1942, vol. 97 (for 1941), p. lxxxiii; Proc. Geol. Assoc. London, 1942, vol. 53, p. 61.

Bodenbender (Guillermo = Wilhelm) [1857–1941], Emeritus Professor of Mineralogy, Geology, and Analytical Chemistry in the University of Córdoba, Argentina, was born on July 2, 1857, at Meerholz in Hessen-Nassau and died on April 20, 1941, at Córdoba. He studied at Marburg and Göttingen, graduating in 1884 with a dissertation on the Tertiary deposits between Frankfurt and Marburg. Before migrating to the University of Córdoba in 1885 he had worked in the museums of the Clausthal Mining Academy and Göttingen University. He wrote on the minerals of Argentina, especially the Sierra de Córdoba. The mineral bodenbenderite was named after him.

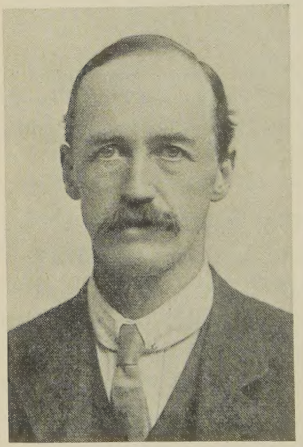
R. J. Davel, Bol. Acad. Nac. Cienc. Argentina, 1927, vol. 30, pp. vii–xv, with portrait and bibliography; J. Keidel, ibid., 1941, vol. 35, pp. 269–308, with portrait. E. M. Hermitte, Anal. Acad. Cienc. Buenos Aires, 1942, vol. 8, pp. 133–138. W. Schiller, Rev. Museo La Plata, 1942, for 1941, pp. 143–148, with portrait and bibliography.

Boeris (Giovanni) [1867–1946], Emeritus Professor of Mineralogy in the University of Bologna, was born at Chivasso on January 1, 1867, and died at Bologna on April 1, 1946. He studied at Pavia and Bologna and in 1903 was professor of mineralogy at Sassari, then at Palma, and since 1905 for 32 years at Bologna. His papers (1890–1925) dealt with

the crystallography of organic compounds and Italian minerals (tridymite, perovskite, epidote, &c.). Amongst the organic compounds found in lignite deposits he described simonellite.

C. Andreatta, Rend. Soc. Min. Ital., 1946, vol. 3, reprint 3 pp.; Rend. Accad. Naz. Lincei, 1946, ser. 8, vol. 1, pp. 1216–1217.

Bowman (Herbert Lister) [1874–1942], Emeritus Professor of Mineralogy and Crystallography in the University of Oxford, was born at Kensington on March 15, 1874, and died at Oxford on April 22, 1942. His father, John Herbert Bowman, was assistant secretary in the Bank of England. Educated at Eton and New College, Oxford, he graduated in chemistry and physics, and was one of the first pupils there of H. A. Miers. He was appointed demonstrator in mineralogy in 1898 and succeeded Miers as professor in 1909, retiring in 1941. He was also a fellow and vice-president of Magdalen College and Secretary to the Delegates of the University Museum. During 1898 he was engaged in research work on the crystallography of monazite and perovskite under P. Groth in the University of München, and his first paper, published in the Zeitschrift für Mineralogie in 1899, was on the crystallography of some organic compounds. He joined this Society in 1897 and was vice-president in 1909–24, serving on the Council with unfailing regularity during several periods between 1903 and 1941. Between 1900 and 1914 he contributed to this Magazine a dozen outstanding papers on various minerals and on Indian meteorites. But since that period, after munition work in the 1914–18 war, he devoted himself entirely to teaching, the arrangement of the mineral collection, and the preparation of a new edition of Miers's well-known text-book 'Mineralogy', and unfortunately no more papers on original work appeared. He was a slow but extremely careful worker, and with his meticulous attention to minute details he appears to have had some difficulty in finally winding up any piece of work. He was interested in Swiss minerals, visiting Switzerland annually, and one from the Binnenthal which had



H. L. BOWMAN (in 1924)

been named 'bowmanite' he was able to prove was identical with hamlinite.

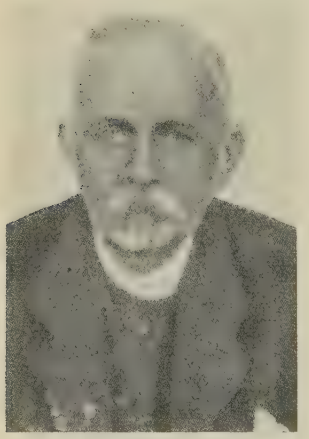
R. C. Spiller, Nature, London, 1942, vol. 149, p. 662. L. J. S[pencer], Quart. Journ. Geol. Soc. London, 1943, vol. 98 (for 1942), p. lxxi. Proc. Geol. Assoc. London, 1944, vol. 55, pp. 39–40.

Bragg (*Sir* William Henry) [1862–1942], a pioneer in the research on crystal-structure by means of X-rays, was born on July 2, 1862, at Westward, near Wigton in Cumberland, where his father was a small farmer, and died in London on March 12, 1942. After graduating at Cambridge as third wrangler in the mathematical tripos, he was successively professor of physics in the University of Adelaide, South Australia (1886–1908), University of Leeds (1909–15), and University College, London (1915–23), and since 1923 Director of the Royal Institution and the Davy-Faraday Research Laboratory in London. A remarkable fact is that he did no research work and had published very little before the age of 42, then becoming interested in radioactivity and X-rays. With his previous experience of X-rays he seized upon the opportunity offered by crystals in 1912, and much of the early work was done with the ionization spectrometer which he devised. This work, done with his son W. L. Bragg (now Sir Lawrence Bragg), gained for them the Nobel prize for physics in 1915, and their book 'X rays and crystal structure' (1915) passed through several editions. Afterwards, at the Royal Institution he collected and inspired a team of research workers, and he emphasized the importance of research work in industry. He had a wonderful knack of explaining things simply and clearly in his popular lectures and popular books. He very modestly bore many honours: knighted K.B.E. in 1920 and Order of Merit (O.M.) in 1931; President of the British Association in 1928 and of the Royal Society in 1935–40; honorary doctor of sixteen universities; &c. The first mineral, (Pt,Pd,Ni)S, to be discovered by X-rays was very appropriately named braggite (this Magazine, 1932, vol. 23). He joined our Society in 1923 (after giving a lecture, this Magazine, vol. 19), and was vice-president in 1933–36.

Les Prix Nobel en 1914–1918, Stockholm, 1920, pp. 100–101, with portrait. E. N. da C. Andrade and nine others, Nature, London, 1942, vol. 149, pp. 346–351. H. A. M[iers], Museums Journ. London, 1942, vol. 42, pp. 36–37. W. F. G. Swann, Science, New York, 1942, vol. 95, pp. 595–596; Sci. Monthly (Amer. Assoc. Adv. Sci.), 1942, vol. 54, pp. 380–382, with portrait. G. F. H. Smith and B. W. Anderson, Gemmological News, London, 1942, in Watchmaker, Jeweller & Silversmith, vol. 68, p. 230, with portrait. E. N. da C. Andrade, with bibliography by K. Lonsdale,

Obituary Notices of Fellows of the Royal Society, 1943, vol. 4, pp. 277–300, with portrait. G. Aminoff, Geol. För. Förh. Stockholm, 1942, vol. 64, p. 184. C. Mauguin, Compt. Rend. Acad. Sci. Paris, 1945, vol. 221, pp. 724–729.

Brøgger (Waldemar Christofer) [1851–1940], pre-eminent mineralogist, petrologist, and geologist, was born at Kristiania (now Oslo) on November 10, 1851, and died there on February 17, 1940, at the advanced age of 89. After study at the University of Oslo, he was in 1875 appointed assistant on the Geological Survey of Norway, and in 1876 also curator of the mineral collection in the university and later assistant in mineralogy and palaeontology. In 1881 he became professor of mineralogy and geology in the University (Högskola) of Stockholm, returning to Oslo in 1890 as professor of the same subjects, from which post he retired in 1916. He was Rector of the university, a member of the Norwegian parliament, and prominent in public affairs. His first paper, in 1873, was zoological, but under the influence of T. Kjerulf (whom he eventually succeeded as professor) he turned to mineralogy and geology. A geological paper followed in 1874 (published by the Geological Society of London, and in the same journal another in 1914), a mineralogical paper in 1875, and in 1876 a paper (with G. vom Rath) on large crystals of enstatite from Norway was communicated to the Crystallological Society in London. His many and voluminous published works covered a wide range in geology—palaeontology, stratigraphy, tectonics, mapping, petrology, glaciology, prehistory, and archaeology. Up to 1900 he is credited with 48 titles in the Royal Society Catalogue of Scientific Papers. The memoir on the minerals of the pegmatite veins of the augite- and nepheline-syenites of southern Norway was a remarkable achievement, occupying a whole volume of the Zeitschrift für Krystallographie und Mineralogie (vol. 16, 898 pp., 1890) and describing more than 70 minerals, several of them new species. A later series of papers on the minerals of the granite-pegmatites remained unfinished. Of the 29 mineral names due to him most are of rare rare-earth minerals. Bröggerite, named after him in 1884, is a Norwegian



W. C. BROGGER

variety of uraninite. His most intensive work was in petrology, and the new rock names proposed by him are bewildering in their number. The brilliance of Brøgger's work was recognized in all countries. In England he was honorary member of the Royal, Geological, and (since 1895) Mineralogical Societies, honorary doctor of the Universities of Cambridge and Oxford, and was awarded the Murchison and Wollaston medals of the Geological Society.

Encycl. Brit., 11th edit., 1910, vol. 4, p. 626. Norsk Geol. Tidsskrift, 1931, vol. 12, dedicated to W. C. Brøgger on his 80th birthday. Ved W. C. Brøggers bortgang, gravferd og minnemøte, Norske Videnskaps-Akad. Oslo, 1940, 106 pp., with portrait and bibliography. V. M. Goldschmidt, Årbok Norske Videnskaps-Akad., 1941, for 1940, pp. 29–53; O. Broch, ibid., pp. 53–60. W. P. Sommerfeldt, Norsk Geol. Tidsskrift, 1941, vol. 20 (for 1940), pp. 199–249, bibliography. H. Shetelig, Naturen, Bergen, 1940, vol. 64, pp. 97–99, with portrait. G. De Geer, Geol. För. Förh. Stockholm, 1940, vol. 62, pp. 109–111, with portrait; P. Quensel, ibid., pp. 112–120, with 2 portraits. H. Backlund, K. Vetenskaps-Soc. Årsbok, Upsala, 1940, pp. 23–26, with portrait. O. B. Bøggild, Medd. Dansk Geol. For., 1940, vol. 9, pp. 646–648, with portrait. W. H. Bragg, Proc. Roy. Soc. London, Ser. A, 1940, vol. 177, p. 7. C. E. Tilley, Obituary Notices of Fellows of the Royal Society, 1941, vol. 3, pp. 503–517, with portrait and bibliography. O. Holtedahl, Nature, London, 1940, vol. 145, p. 652. J. S. F[lett], Quart. Journ. Geol. Soc. London, 1942, vol. 97 (for 1941), pp. lxxvi–lxxviii. A. Lacroix, Compt. Rend. Acad. Sci. Paris, 1940, vol. 210, pp. 321–323. P. Eskola, Naturwiss., 1940, vol. 28, pp. 617–619, with portrait. O. Holtedahl, Geol. Rundschau, 1940, vol. 31, pp. 297–299, with portrait; H. Cl[oos], ibid., pp. 300–301, with portrait. H. Schneiderhöhn, Zentralbl. Min., Abt. A, 1941, pp. 25–31, with portrait. L. Tokody, Földtani Közlöny, Budapest, 1941, vol. 71, pp. 177–180, with portrait. O. Andersen, Amer. Min., 1941, vol. 26, pp. 167–173, with portrait. G. De Geer, Proc. Geol. Soc. Amer., 1941, for 1940, pp. 167–170, with portrait and bibliography. N. L. Bowen, Journ. Geol. Chicago, 1940, vol. 48, pp. 444–445.

Cahn (Lazard) [1865–1940], mineral collector and dealer, was born of French parents at St. Joseph, Missouri, on May 23, 1865, and died at Colorado Springs, Colorado, on May 22, 1940. He carried only small stocks of choice crystallized material, working at home, first in New York City and afterwards since 1907, to be nearer the collecting grounds, at Colorado Springs. He was especially interested in the crystalline forms of minerals and the regular intergrowth of crystals of different species, and had measured crystals with C. Palache at Harvard University and with V. Goldschmidt at Heidelberg. He described regular intergrowths of topaz and garnet and of rutile and haematite. A large collection was formed of micro-mounts of minutely crystallized minerals. A rare hydrous boro-arsenate of calcium, named cahnite after him by Palache, is the only known example of the tetragonal-

bisphenoidal class of symmetry [M.A. **8**–26]. He was vice-president in 1928 of the Mineralogical Society of America, and had been a member of our Society since 1923.

C. Palache, Amer. Min., 1941, vol. 26, pp. 174–177, with portrait. J. K. Halliburton, Rocks and Minerals, Peekskill, N.Y., 1947, vol. 22, pp. 722–723.

Clerici (Enrico) [1862–1938], Italian geologist, was born at Roma on October 15, 1862, and died on August 26, 1938. He taught in various schools and since 1903 was docent in geology in the University of Roma. At the time of his death he was secretary of the Italian Geological Society. He devised apparatus for mineral separation, and in 1907 investigated various heavy liquids, including aqueous solutions of many salts of thallium. The most suitable was found to be a mixture in equal parts of thallium formate and thallium malonate. His final paper on this, which has come to be known as Clerici solution, appeared in 1922 [M.A. **2**–487, **6**–454]. He also devised a method for determining the refractive index of a liquid under the microscope. Since 1885 he had produced 173 papers and notes.

A. Neviani, Boll. Soc. Geol. Ital., 1939, vol. 57 (for 1938–39), pp. cxxi–cxliii, with portrait and bibliography.

Cullis (Charles Gilbert) [1871–1941], Emeritus Professor of Mining Geology in the Imperial College of Science and Technology, London, was born at Gloucester on February 16, 1871, and died at Hindhead, Surrey, on April 27, 1941. From Mason College (now University of Birmingham) as a pupil of Charles Lapworth he went in 1891 to the Royal College of Science in London as a pupil of J. W. Judd, gaining the Murchison medal and becoming demonstrator in geology in 1892, and later assistant professor of economic mineralogy (1914–30) and professor of mining geology (1930–36). In 1899 he gained the D.Sc. degree of the University of London with a thesis 'The chemical and mineralogical changes which take place in coral-rocks as illustrated from the boring at Funafuti' (privately printed, Gloucester, 1899); and in 1904 his chapter on the mineralogical changes, distinguishing calcite, aragonite, and dolomite by colour reactions, appeared in the Royal Society report on the atoll of Funafuti. These papers gave great promise for future research work, but in the intervals between intensive teaching and personal interest in his many students he switched over to preparing private reports for mining companies. In 1922 with A. B. Edge a valuable report was

prepared for the Colonial Office on the copper deposits of Cyprus, followed in 1923 and 1924 by papers on the mines and geology. A magnificent specimen of cupriferous melanterite from Cyprus, obtained by him for the British Museum collection, was described in this Magazine (vol. 22). He was president of the Institution of Mining and Metallurgy in 1937–38. He joined our Society in 1899, serving several times on the Council between 1903 and 1939, vice-president in 1930–33, and contributed to this Magazine (vol. 18) an obituary notice of J. W. Judd.

Trans. Inst. Mining & Metall., 1942, vol. 51 (for 1941–42), p. 332. W. R. Jones, Nature, London, 1941, vol. 147, p. 636; Quart. Journ. Geol. Soc. London, 1942, vol. 97 (for 1941), pp. lxxxiv–lxxxv; Proc. Geol. Assoc. London, 1942, vol. 53, pp. 62–63.

D'Achiardi (Giovanni) [1872–1944], Professor of Mineralogy in the University of Pisa, was born at Pisa on April 25, 1872, and died at Fauglia near Pisa on September 9, 1944. He was the son and pupil of Antonio D'Achiardi (1839–1902), whom he succeeded in 1903 as professor at Pisa. Since 1894 he wrote many papers on Italian minerals, more especially those from Tuscany. A series of papers dealt with the minerals found in the Carrara marble quarries. From Elba a mimetic zeolite was named dachiardite in memory of his father, and amongst the boron minerals from the fumaroles and lagoons of Tuscany he described ginorite.

A. Bianchi, Atti (Rend.) Accad. Naz. Lincei, Cl. Sci. fis. mat. nat., 1946, ser. 8, vol. 1, pp. 1214–1215.

Davison (Ernest Henry) [1877–1944], Cornish geologist, died at Derby on August 9, 1944, as the result of a fall in outcrop-coal workings. He was a member of this Society since 1936. He was educated at Cheltenham Grammar School and graduated (B.Sc., 1902) at the University of London. After teaching science in a school in Cheshire, he was appointed in 1909 to the Camborne School of Mines, becoming head of the geology department and retiring in 1940. For many years he was an active member and honorary secretary of the Royal Geological Society of Cornwall, and president in 1933–34. He wrote many papers on the geology and ore-deposits of Cornwall and a 'Handbook of Cornish geology' (1926), where he was an excellent leader of field excursions.

H. G. D[ines], Quart. Journ. Geol. Soc. London, 1945, vol. 100 (for 1944), pp. lxviii–lxix. Proc. Geol. Assoc. London, 1945, vol. 56, pp. 50–51. Mining Mag. London, 1945, vol. 72, p. 38.

Dittler (Emil) [1882–1945], Professor of Mineralogy in the University of Vienna (Wien), was born at Graz in Styria on October 29, 1882, and died in Vienna on November 3, 1945. He graduated at Graz and at Vienna was a pupil of F. Becke and C. Doelter. In 1921 he was appointed extraordinary professor of mineralogy and petrology, and in 1928 succeeded C. Doelter as ordinary professor and director of the mineralogical institute of the university (as distinct from that of mineralogy and petrology, of which F. Becke and A. Himmelbauer were directors). He was deprived of this post by the Nazis in 1938, but reinstated in 1945 when a sick man. Since 1908 he did much work on the artificial production of minerals, especially silicate melts and felspars; and made many chemical analyses of minerals, rocks, meteorites, and tektites. He also wrote on colloidal chemistry in relation to clays and bauxite. A text-book on the methods of rock analysis was published in 1933.

English (George Letchworth) [1864–1944], mineral collector and dealer, was born at Philadelphia, Pennsylvania, on June 14, 1864, and died, after a long illness, at Winter Park, Florida, on January 2, 1944. After a school education and six years in an insurance office in Philadelphia, he opened a mineral store there in partnership with E. C. Atkinson in 1887, removing to New York in 1890. This business was sold in 1905 to Ward's Natural Science Establishment of Rochester, N.Y., and English then devoted his whole time to monazite mining in North and South Carolina, in which he had been interested since 1894. From 1913 until 1922 he was manager of Ward's mineral department and until 1934 their consulting mineralogist. In connexion with his own business and later with that of Ward's he made many collecting expeditions to all parts of the world, buying up whole mineral collections. He wrote a popular well-illustrated book 'Getting acquainted with minerals' (1934; M.A. **6**–49, 244) and a useful book of reference 'Descriptive list of new minerals, 1892–1938' (1939; M.A. **7**–313); and another book 'In the field for minerals' was completed before his death. He was vice-president of the Mineralogical Society of America in 1927, and joined our Society in 1920, resigning in 1936. The mineral englishite was named after him.

P. Zodac, Rocks and Minerals, Peekskill, N.Y., 1944, vol. 19, pp. 42–44, with portrait. R. C. Vance, Amer. Min., 1945, vol. 30, pp. 130–134, with portrait.

Fersman (Aleksandr Evgenievich) Ферсман (Александр Евгеньевич) [1883–1945], distinguished Russian mineralogist and geochemist, and an honorary member of our Society, was born on November 8 (October 27, old style), 1883, at St. Petersburg and died on May 28, 1945, at Sochi on the Black Sea. He studied at Moscow University under V. I. Vernadsky, where he became assistant, and in 1912 was assistant in the mineralogical museum of the Academy of Sciences in St. Petersburg, becoming director in 1919. The museum was later incorporated in the Lomonosov Institute and in 1934 was transferred to Moscow. His first papers in 1904, on the crystallography of some organic compounds, were followed by many others on minerals, notably Russian zeolites and the palygorskite group. An elaborate study with Victor Goldschmidt at Heidelberg on the crystallography of diamond was published as a book in 1911. Later he did intensive work in organizing and leading expeditions in many widely separated regions of the U.S.S.R. for exploring and investigating the mineral resources. His theories on geochemistry (although they appear sometimes to be involved and speculative) have led to the discovery of some deposits of economic importance. Remarkable developments were made in the Kola peninsula, where enormous deposits of apatite are now mined. He was an indefatigable worker. A selection of his publications since 1915 noticed in this Magazine numbers 75. His books deal with geochemistry, pegmatites, precious stones, the Kola peninsula, and a popular book 'Interesting mineralogy' which passed through several editions in Russian and German. He named 19 new minerals, many of them from the Kola peninsula, and fersmanite from the same region was named after him; another mineral has been named fersmite. He was elected a member of the Academy of Sciences in 1919, and later received the Lenin and Stalin Prizes. The Wollaston Medal of the Geological Society of London was awarded to him in 1943. His untimely death at the age of 61 was a result of bad health and overwork for a number of years.

A. E. FERSMAN

Fersman jubilee volume for his 60th birthday, 1943. A volume 'Questions of mineralogy, geochemistry, and petrography' (Acad. Sci. U.S.S.R., 1946, 323 pp.,

with portrait) containing 45 papers by several authors is dedicated to his memory. V. K. Zdravomyslov and O. V. Isakova, Bibliography, Acad. Sci. USSR, 1940, 90 pp., with portrait. B. M. Kupletsky, Bull. Acad. Sci. URSS, Sér. Géol., 1944, no. 1, pp. 35–41, with portrait; N. A. Smolyaninov, ibid., pp. 42–48; A. A. Saukov, ibid., pp. 49–57. Compt. Rend. (Doklady) Acad. Sci. URSS, 1945, vol. 47, pp. 607–610, with portrait. V. A. Obruchev, Moscow News, May 25, 1945. Six articles by various authors in Bull. Soc. Nat. Moscow, 1946, n. ser., vol. 51, Sect. Géol., vol. 21, no. 1, pp. 63–79, 90–120, with portrait. Seven articles by various authors in Mém. Soc. Russe Min., 1946, ser. 2, vol. 75, pp. 47–88, with portraits. C. E. Tilley, Nature, London, 1945, vol. 156, pp. 12–13. L. J. Spencer, Amer. Min., 1946, vol. 31, pp. 173–178, with portrait. H. G. Backlund, Geol. För. Förh. Stockholm, 1945, vol. 67, pp. 539–548.

Flett (*Sir* John Smith) [1869–1947], formerly Director of the Geological Survey of Great Britain (1920–35) and a past-President of this Society (1930–33), was born at Kirkwall, Orkney, on June 26, 1869, and died at Ashdon, Essex, on January 26, 1947. After a brilliant career at Edinburgh University, gaining many scholarships and prizes and graduating in arts, science, and medicine (M.B., C.M.), he started as a medical practitioner. But in 1895 he became assistant to James Geikie and lecturer in petrology in the university. He joined the Geological Survey in 1901, succeeding J. J. H. Teall as petrographer, and from 1911 was assistant to the director in the Scottish office. In 1920 he succeeded A. Strahan as director, retiring in 1935, shortly after the opening of the new Geological Museum, library, and workrooms at South Kensington and the centenary celebrations. He had the satisfaction of seeing the completion of an excellent piece of work, and in 1937 he produced an interesting and useful volume 'The first hundred years of the Geological Survey of Great Britain'.

J. S. FLETT (about 1925)

Early papers before joining the survey dealt with the Old Red Sandstone and trap dikes of the Orkney Islands and the petrography of various Scottish rocks. In 1903 he gave with Tempest Anderson a report to the Royal Society on the volcanic eruptions of the Soufrière in the West Indies. Many articles on petrology were written for the 11th edition of the 'Encyclopaedia Britannica' (1910–11). The results of most

of his work appeared in the Memoirs and Summary of Progress of the Geological Survey. With his wide knowledge of petrology he wisely refrained from burdening the literature with a multitude of new rock names, the only one being crinanite (1911). No new mineral names were coined, but he recorded melilite as a British mineral.

W. F. P. McLintock, Nature, London, 1947, vol. 159, pp. 326-327. S. Gavelin, Geol. För. Förh. Stockholm, 1947, vol. 69, p. 254.

Foote (Harry Ward) [1875–1942], Professor of Chemistry in Yale University, was born at Guilford, Connecticut, on March 21, 1875, and died on January 14, 1942. After graduating at Yale he studied under W. Ostwald in Leipzig, returning to Yale as instructor and becoming in 1912 full professor of physical and analytical chemistry. He had studied mineralogy under S. L. Penfield in collaboration with whom bixbyite, clinohedrite, and roeblingite were described as new minerals and a new chemical formula deduced for tourmaline. With J. H. Pratt wellsite was described as a new mineral; and with W. M. Bradley a series of papers was devoted to solid solution in minerals with reference to nepheline, analcime, albite, chrysocolla, calcite, and dolomite. Several of his chemical papers were on mixed crystals of various inorganic salts, especially of caesium which he extracted from the pollucite of Rumford, Maine. He was a fellow of the Royal Geographical Society of London.

J. E. Vance, Amer. Journ. Sci., 1942, vol. 240, pp. 302–308, with bibliography. T. B. Johnson, Science, New York, 1942, vol. 95, pp. 241–242.

W. E. FORD

Ford (William Ebenezer) [1878–1939], Professor of Mineralogy in Yale University, was born at Westville, a suburb of New Haven, Connecticut, on February 18, 1878, and died at New Haven on March 23, 1939. Entering the Sheffield Scientific School of Yale University as a student of chemistry in 1896, he came under the inspiring influence of S. L. Penfield and became successively assistant in mineralogy (1900), instructor, assistant professor (1906), and professor (1920). His earliest papers in 1900 were in collaboration with Penfield, and later papers were often in collaboration with W. M. Bradley. Valuable papers were produced on the relation between the chemical composition and physical

properties of the garnet and calcite isomorphous groups and of beryl, labradorite, and the amphiboles, emphasis being laid on the importance of determining all the data on the same sample of material. Rickardite ($Cu_4Te_3$), margarosanite ($Pb(Ca,Mn)_2(SiO_3)_3$), pyroxmangite, and skemmatite were described as new minerals. Since 1917, however, no more descriptive papers were published, his energies being diverted to the teaching of large classes and the preparation of new editions of the several Dana books on mineralogy. He assisted E. S. Dana in the second appendix (1909) to the sixth edition of the 'System', and produced the third appendix in 1915. New editions of the 'Manual' were issued in 1912 and 1929, and of the useful 'Textbook' in 1922 and 1932. But the most strenuous work was in the preparation for a new edition of the 'System' (the first edition of which by J. D. Dana appeared in 1837 and the sixth edition in 1892), for which Ford became editor-in-chief in 1920; and this work, as with E. S. Dana in the preparation of the sixth edition, led to a breakdown in health. The task was then handed over to Harvard University under the charge of Charles Palache.

A. Knopf, Amer. Min., 1940, vol. 25, pp. 174–180, with portrait and bibliography; Proc. Geol. Soc. Amer., 1940, for 1939, pp. 187–193, with portrait and bibliography. C. H. Warren, Amer. Journ. Sci., 1940, vol. 238, pp. 63–66.

Gibbs (*Lady* Agnes Mary) [1877–1939], daughter of the Rev. W. J. Rowland and wife of Sir Philip Gibbs, was born on October 18, 1877, and died at her home at Shamley Green, Surrey, on October 7, 1939. She had been a member of this Society since 1933 and of the Geological Society since 1932. Working at the Imperial College of Science and Technology she made detailed chemical analyses of rocks and rock-forming minerals.

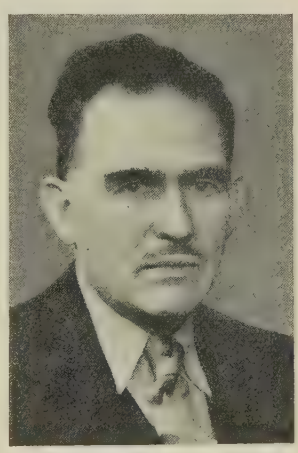
D. L. R[eynolds], Quart. Journ. Geol. Soc. London, 1940, vol. 97, pp. lxvii–lxviii.

Ginori-Conti (Piero) [1865–1939], Prince of Trevignano and Italian senator, was born at Firenze (Florence) on June 3, 1865, and died there on December 3, 1939. He introduced large-scale methods in the boric-acid industry at the fumaroles (soffioni) and lagoons in the Larderello district of Tuscany, extracting also ammonia, carbon dioxide, and rare gases, and using the high-pressure steam of the fumaroles for electric power [M.A. **4**–310]. A hydrous borate of calcium has been named ginorite after him [M.A. **5**–434]. He was a frequent visitor to London, being a fellow of the Chemical Society, member of the Society of Chemical Industry and of the Institution of Chemical Engineers, and

honorary member of the Royal Institution and of the Royal Society of Arts.

Nature, London, 1940, vol. 145, p. 380. J. Gerard, Journ. Chem. Soc. London, 1940, pp. 563–564. F. Millosevich, Annuario Accad. d'Italia, 1940, vol. 11. D. Marotto, La Chimica e l'Industria, 1939, vol. 21, pp. 651–658.

Goldschmidt (Victor Moritz) [1888–1947], a pioneer in geochemistry and crystal-chemistry, and an honorary member of our Society, was born at Zürich on January 27, 1888, and died at Oslo on March 20, 1947. His father, Heinrich Jakob Goldschmidt (1857–1937) was born at Praha and was professor of chemistry at Zürich, afterwards in 1896 at Heidelberg, and from 1901 at Kristiania (now Oslo). The son was consequently educated in Norway and he also studied in Vienna and Munich. He was not a relative of Victor Goldschmidt (1853–1933), the crystallographer of Heidelberg: the two have sometimes been confused in catalogues. In 1914 he succeeded W. C. Brøgger as professor of crystallography, mineralogy, and petrology in the university of Kristiania, and from 1929 was professor of mineralogy at Göttingen, returning to Norway in 1935 as professor of mineralogy and geology. In 1942 he was put in a German concentration camp, but escaping to Sweden he came to England in 1943. Here he was elected a foreign member of the Royal Society and was awarded the Wollaston medal of the Geological Society, and for a time he worked at the Macaulay Institute for Soil Research at Aberdeen and at the Rothamsted Experimental Station at Harpenden. He returned to Norway in 1946.



V. M. GOLDSCHMIDT (in 1943)

His first paper in 1906 was on the pyroluminescence of quartz, followed in 1908 by others on the radioactivity of minerals and on argyrodite (a germanium mineral) from Bolivia. In 1911–21 a series of voluminous papers was published on the metamorphic rocks of the south of Norway in which physico-chemical principles were employed in elucidating the paragenesis of the constituent minerals. In 1922–23 came papers on the composition of zones in the earth and their comparison with meteorites. Another long series of papers 'Geochemische

Verteilungsgesetze der Elemente' (I–IX, 1923–38) dealt with their crystal-structure, atomic and ionic radii, and their relative abundance and distribution. Still another series, mainly from the Göttingen laboratory, dealt with the geochemistry of individual elements, e.g. germanium which was found in coal-ash, meteorites, and many kinds of minerals and rocks. For this work improved methods of optical and X-ray spectroscopy were devised. He was chairman (1917–30) of the commission for the development of the economic minerals of Norway, on which he produced numerous reports.

C. E. Tilley, Nature, London, 1947, vol. 159, p. 700; M. Born, ibid., p. 701.

Guild (Frank Nelson) [1870–1939], Emeritus Professor in the University of Arizona, was born at Jaffrey, New Hampshire, on December 28, 1870, and died at Tucson, Arizona, on March 12, 1939. He graduated at the University of Vermont, and later studied at Chicago, Paris, Heidelberg, and Stanford University. After a few years of school-teaching he was appointed in 1897 professor of chemistry and mineralogy in the University of Arizona at Tucson, becoming in 1923 head of the department of geology and mineralogy. Owing to ill health he retired in 1934, but continued microscopical work in his private laboratory at home. He described various minerals from Arizona, including a new species flagstaffite, which he later identified with terpin hydrate, and he wrote a small book 'The mineralogy of Arizona' (1910). He was specially interested in the microscopical study of silver ores. An Arizona mineral, guildite, was named after him.

M. N. Short, Amer. Min., 1940, vol. 25, pp. 181–183, with portrait and bibliography.

Hackman (Victor Axel) [1866–1941], Finnish petrologist, was born at Viborg on April 27, 1866, and died at Helsinki on November 26, 1941. He studied at Helsinki University under W. Ramsay and at Heidelberg (1891–93) under H. Rosenbusch, graduating with a dissertation on the alkalic rocks of Sierra de Monchique, Portugal. He was lecturer in petrology at Helsinki University (1899–1912) and on the staff of the Geological Survey of Finland (1903–35). With W. Ramsay the nepheline-syenites of the Kola peninsula were first described in 1894, and from them a new mineral lamprophyllite. A pink variety of sodalite, named hackmanite after him, has since been found in Ontario and India; its colour rapidly vanishes on exposure to light, returning again in the dark.

E. H. Kranck, Geol. För. Förh. Stockholm, 1942, vol. 64, pp. 78–79.

HARKER (Alfred) [1859–1939], distinguished as a petrologist both as a research worker and as a teacher, was born at Hull on February 19, 1859, and died at Cambridge on July 28, 1939. His interest in geology was no doubt aroused by the Cambridge University extension lectures given by J. J. H. Teall in Hull in 1878. At Cambridge he was eighth wrangler in the mathematical tripos in 1882, then taking a first class in part I of the natural sciences tripos, and in the following year another first class in part II in physics with geology as a subsidiary subject. The first lectures he gave were on physics.

A. HARKER (in 1935)

In 1884 he was appointed demonstrator in geology, university lecturer in 1904, and in 1918 a special readership in petrology was created for him, which he held until 1931, retiring with the title of Emeritus Reader. But he still continued to work as honorary curator on the extensive rock collection with 40,000 thin slices, which during many years he had gradually built up in the Sedgwick Museum. (At the time I had the advantage of being one of Harker's pupils the collection was contained in two small cabinets in a basement room of the old University Library.) His early papers dealt with slaty cleavage (1885) and igneous rocks of North Wales. Later, often in collaboration with J. E. Marr, a series of papers appeared on the rocks of the Lake District. From 1895 to 1905 his vacations from Cambridge were spent in the service of the Geological Survey mapping the igneous rocks of the Inner Hebrides on which important memoirs were written. His 'Petrology for students' (seven editions, 1895 1935) was used by generations of students and was translated into French. Other noteworthy books are 'The natural history of igneous rocks' (1909), and 'Metamorphism' (1932 and 1939, and Russian translation). A posthumous book 'The West Highlands and the Hebrides' appeared in 1941. He was very sparing in the coining of rock names, no more than allivalite, harrisite, marscoite, and mugearite. He was elected a Fellow of the Royal Society in 1902 and was awarded a Royal Medal. He was president of the Geological Society in 1916–18 and received the Murchison and Wollaston medals. He was a member of the Mineralogical Society since 1885, being our senior member. To this Magazine

he contributed a few concise papers on hornblende and optical extinction-angles, and between 1889 and 1897 wrote many good abstracts of petrological papers.

Eminent living geologists, Alfred Harker, Geol. Mag., 1917, dec. 6, vol. 4, pp. 289–294, with portrait and bibliography. 80th birthday, Nature, London, 1939, vol. 143, p. 293. C. E. Tilley, Nature, London, 1939, vol. 144, pp. 316–317. R. H. Rastall, Proc. Yorkshire Geol. Soc., 1939, vol. 24, pp. 73–75, with portrait. A. C. Seward and C. E. Tilley, Obituary Notices of Fellows of the Royal Society, 1940, vol. 3, pp. 197 216, with portrait and bibliography. J. S. F[lett], Quart. Journ. Geol. Soc. London, 1940, vol. 96, pp. lxix–lxxi. S. J. Shand, Proc. Geol. Soc. Amer., 1940, for 1939, pp. 207–209, with portrait and selected bibliography.

Hibsch (Josef Emanuel) [1852–1940], Emeritus Professor of Mineralogy, Petrology, and Geology in the German Agricultural Academy at Tetschen (Děčín) in northern Bohemia, was born of peasant parents at Hummeln (Homoly) near Leitmeritz (Litoměřice) in Bohemia on March 26, 1852, and died in Vienna (Wien) on November 4, 1940. He studied at the Technical High School in Vienna where he was assistant in 1874–78, and was afterwards a schoolmaster in Pilsen (Plzeň). In 1880 he was appointed professor in the Agricultural Institute (afterwards Academy) at Tetschen. In 1886–87 he was granted a year's leave to study petrology under F. Zirkel at Leipzig where he gained the degree of Ph.D. After his retirement from the Agricultural Academy in 1914 he resided in Wien, but every summer he visited the Midland Mountains (Mittelgebirge) of Bohemia to continue his work of mapping in this interesting area of igneous rocks. This work was commenced single-handed in 1891, and twenty sheets of beautifully prepared geological maps on a scale of 1:25,000, together with detailed explanatory texts in which the mineral occurrences are noted, have been issued at intervals from 1895 to 1930. A useful summary of this work with a geological map on the scale of 1:100,000 was published in 1926 [M.A. **3**–277], together with a portrait, biographical notes, and bibliography of the author. He published a text-book on geology for farmers and foresters, and in Wien he wrote mineralogical papers in collaboration with

J. E. HIBSCH (in 1925)

F. Becke and E. Dittler. He was twice president of the Mineralogical Society of Wien, and the second edition of the society's useful 'Taschenbuch' was edited by him. The mineral hibschite from Bohemia, named after him in 1905, has recently, after a period of obscurity, come into prominence under the synonyms plazolite, hydrogarnet, garnetoid, and grossularoid. The name hibschite is transliterated into Russian as гибшит, and this has been transliterated back again as gibbsite!

C. Purkyně, Věstník Státního Geol. Ústavu Republiky Československé, 1932, vol. 8, pp. 78–84, with portrait and bibliography, for his eightieth birthday. H. Michel, Mitt. Wien. Min. Gesell., 1941, no. 107 in Min. Petr. Mitt. (Tschermak), 1941, vol. 53, pp. 67–84, with portrait and bibliography.

Himmelbauer (Alfred) [1884–1943], Professor of Mineralogy in the University of Wien (Vienna), was born at Wien on February 6, 1884, and died there after a long illness on April 18, 1943. After study under G. Tschermak and F. Becke he was an assistant in the mineralogical and petrographical institute of the University of Wien. In 1914 he joined an expedition to Siberia where, on account of the war, he was detained until 1920. From 1921 to 1927 he was professor of mineralogy, petrography, geology, and pedology (soil science) in the Agricultural High School (Hochschule für Bodenkultur) at Wien. In 1927 he succeeded F. Becke as professor in the university and director of the mineralogical and petrographical institute. He was joint editor of Tschermak's 'Mineralogische und Petrographische Mitteilungen'. His first paper, in 1906, was on ilvaite and the datolite group, and in 1910 he had a good paper on the scapolite group. A graphical method was described for determining the orientation of section planes of meteoritic irons. Other papers dealt with mineral occurrences in the Austrian Alps, and several articles were contributed to C. Doelter's 'Handbuch der Mineralchemie'.

Neues Jahrb. Min. Monatshefte, Abt. A, 1943, p. 128. A. Marchet, Min. Petr. Mitt. (Tschermak), 1943, vol. 55, pp. iii–viii, with portrait and bibliography. F. Raaz, Neues Jahrb. Min. Monatshefte, Abt. A, 1943, pp. 164–167.

Hodge-Smith (Thomas) [1894–1945], Australian mineralogist, was born at Swindon, England, on October 27, 1894, son of the Rev. Michael Smith, Presbyterian minister, and was taken to Australia at the age of two. He died suddenly on June 8, 1945. After education at the High School, Technical College, and University of Sydney, he joined the Geological Survey of New South Wales in 1913 as an assistant to G. W.

Card in the Mining Museum. He served in the Australian Navy and Army throughout the 1914–18 war and was severely wounded. In 1919 he joined the staff of the Australian Museum in Sydney, where in 1921 he succeeded Dr. Charles Anderson as mineralogist. With the death of Anderson a few months before, New South Wales lost two prominent mineralogists. Earlier papers, from 1923, appeared under the name T. Hodge Smith, but since 1929 he adopted the form T. Hodge-Smith. They dealt with the crystallography of Australian minerals, including zeolites and a new mineral sturtite (Mineralogical notes, nos. 1–6). Several new meteorites were described, and a useful catalogue of Australian meteorites was published in 1939. He was prominent in public affairs. Since 1925 he was teacher of mineralogy in Sydney Technical College, and edited Australian Science Abstracts, 1935–41.

Australian Journ. Sci., 1945, vol. 7, p. 170. Rec. Australian Museum, 1946, vol. 21, pp. 377–379, with portrait and bibliography.

Högbom (Arvid Gustaf) [1857–1940], Emeritus Professor of Mineralogy and Geology in the University of Upsala, was born at Vännäs in northern Sweden on January 11, 1857, and died at Upsala on January 19, 1940. Graduating at Upsala in 1885 he was then docent in geology. In 1891–95 he was on the geology staff of the University (Högskola) of Stockholm, becoming in 1895 professor of mineralogy and geology. In 1896 he returned to Upsala as professor, retiring in 1922. He wrote on a wide range of geological subjects and prepared several memoirs for the Geological Survey of Sweden. His earliest papers were chemical, dealing with double fluorides of tellurium and double wolframates of sodium and rare-earths. In 1887 he made chemical analyses of berzeliite and pyrrhoarsenite. An important paper in 1895 was on nephelinesyenite and alnöite from Alnö. He described the Muonionalusta meteorite from northern Sweden, and had other papers on the statistics of meteorites. Högbomite from Sweden, named after him in 1916, has since been found in emery deposits at three other localities.

Bull. Geol. Inst. Univ. Upsala, 1916, vol. 15, for his 60th birthday, with portrait and bibliography of 145 items. C. Wiman, Bull. Geol. Inst. Univ. Upsala, 1943, vol. 30, pp. 1–55, with portrait and bibliography. L. Ramberg, K. Vetenskaps-Soc. Årsbok, Upsala, 1940, pp. 17–19, with portrait. L. Hawkes, Nature, London, 1940, vol. 145, p. 769. E. Antevs, Proc. Geol. Soc. Amer., 1941, for 1940, pp. 201–208, with portrait and bibliography. N. G. H[örner], Quart. Journ. Geol. Soc. London, 1940, vol. 96, pp. lxii lxiv. H. Nelson, Svensk Geogr. Årsbok, 1940, vol. 16, pp. 152–161, with portrait. L. Post, Ymer (Svenska Sällsk. Antrop. Geogr.), 1940, vol. 60, pp. 41–45, with portrait. E. Ljungner, Geol. Rundschau, 1940, vol. 31, pp. 91–93, with portrait; W. Credner, ibid., pp. 94–96.

HOLLAND (*Sir* Thomas Henry) [1868–1947], a member of this Society since 1896, president in 1933–36, and foreign secretary since 1938, was born on November 22, 1868, at Helston, son of a Cornish farmer who emigrated to Canada, leaving the boy behind to complete his education alone. He died on May 15, 1947, after a short illness in hospital near his new home at Surbiton in Surrey. From the Technical School at Helston he gained in 1885 a national scholarship to the Royal College of Science in London, taking the associateship in geology and acting as assistant to J. W. Judd. Joining the Geological Survey of India in 1890, he was director in 1903–9, and during part of this period he was also professor of geology in the Presidency College at Calcutta. After resigning from the Indian survey he was professor of geology and mineralogy in the University of Manchester until 1916, when he returned to India as head of the board of industries and munitions in connexion with the first world war. In 1922–29 he was Rector of the Imperial College of Science and Technology in London, and in 1929–44 Principal and Vice-Chancellor of the University of Edinburgh.

T. H. HOLLAND (in 1929)

His first paper, in 1889, on felspar crystals from Mull, appeared in this Magazine, and other early papers dealt with the petrology of Indian rocks. A paper entitled 'The petrology of Job Charnock's tombstone' appeared in 1893, and this granitic rock, composed of microcline, hypersthene, blue quartz, and almandine, he named charnockite,[1] the term charnockite series being later (1910) extended to a wide range of acidic and basic rocks containing hypersthene. Monographs were written on corundum (1898) and mica (1902), and much intensive work was done on developing the mineral resources of India, both while on the survey and during his second visit to the country. His main work was that of an administrator: he was president of many scientific and technical societies, and chairman of numerous committees and commissions dealing with a variety of problems. He was president designate

[1] Job Charnock (*d.* 1693), founder of Calcutta. While minerals have often been named after persons, this is exceptional in the case of rocks, the only other example that comes to mind being dolomite.

of the 18th International Geological Congress to be held in London in 1948. Hollandite, an Indian manganese mineral named after him in 1906, has since been found in several other parts of the world.

L. L. Fermor, Nature, London, 1947, vol. 160, pp. 11–13.

Honess (Arthur Pharaoh) [1887–1942], Professor of Mineralogy in Pennsylvania State College, was born at Berea, Ohio, on August 10, 1887, and died suddenly on December 17, 1942. After graduating in 1914 at Oberlin College, Ohio, he was assistant in mineralogy under A. H. Phillips at Princeton University, and in 1917 went to Pennsylvania State College, becoming full professor in 1931. He made a special study of the etch-figures on crystals, his first papers being in 1917, and a useful book was published in 1927 [M.A. 3–318]. He also did some petrographical work and examined oil-sands and clays. He was a member of our Society since 1931.

W. M. Myers, Amer. Min., 1943, vol. 28, pp. 151–154, with portrait and bibliography. P. D. Krynine, Proc. Geol. Soc. Amer., 1943, for 1942, pp. 195–200, with portrait and bibliography.

Koechlin (Rudolf Ignatz) [1862–1939], Austrian mineralogist, was born at Vienna (Wien) on November 11, 1862, and died there on February 11, 1939. He was a pupil of G. Tschermak at the University of Vienna, graduating in 1887. From 1884 he acted as a voluntary worker in the mineralogical and petrographical department of the Vienna Natural History Museum, becoming assistant in 1887 and later curator, retiring in 1922 as emeritus director, but still continuing to work in the collections. His first paper in 1886 was on euclase from the Austrian Alps, and in 1887 he described laurionite as a new mineral. His last paper in 1934 consisted of 'mineralogical gleanings' from his note-books of fifty years. His papers, 39 in number, are marked by concise and precise presentation. In 1911 (2nd edition, 1928) he compiled a long list of mineral names. The mineral koechlinite ($Bi_2O_3.MoO_3$) is named after him. He was a foundation member of the Vienna Mineralogical Society, and its president in 1921–23.

H. Michel, Mitt. Wiener Min. Gesell., 1938, no. 104, in Min. Petr. Mitt. (Tschermak), 1938, vol. 50, pp. 81–86, with bibliography; H. Tertsch, ibid., 1940, vol. 51, pp. 427–428.

Koenigsberger (Johann Georg) [1874–1946], lately Professor of Mathematical Physics and Geophysics in the University of Freiburg,

Baden, was born at Heidelberg on May 7, 1874, and died at Freiburg on December 3, 1946. He studied at Heidelberg, Freiburg, and Berlin, graduating from the last in 1897, and in the same year was appointed assistant in physics in the University of Freiburg, becoming professor in 1904, and retiring in 1936. His work was mainly in physics and geophysics, but he also did much in crystal-physics, especially optics, and in mineralogy. His first paper in 1897 was on the absorption of infra-red rays in birefringent crystals, followed in 1899 on the colouring matter of smoky-quartz. He was also an early worker on the optical determination of felspars and of opaque minerals in ores [Min. Mag. **13**–203]. His well-known work on the crystal-lined cavities of the Alpine mineral veins dates back to 1901, followed by many papers and by monographs in 1917–19 [M.A. **1**–328], and he was a co-author of 'Die Mineralien der Schweizeralpen' (2 vols., 1940) [M.A. **8**–49]. The paragenesis of the minerals was considered in relation to rock metamorphism, and the minerals were prepared artificially by hydrothermal synthesis.

J. Schroeter, Schweiz. Min. Petr. Mitt., 1947, vol. 27, pp. 236–246, with portrait. Nature, London, 1947, vol. 159, p. 19.

Kolbeck (Friedrich Ludwig Wilhelm) [1860–1943], Emeritus Professor of Mineralogy in the Mining Academy (Bergakademie) at Freiberg, Saxony, was born on January 12, 1860, son of F. W. Kollbeck, a master-tailor at Dresden, and died at Freiberg on February 6, 1943. He graduated at Leipzig in 1883 with a dissertation 'Porphyrgesteine des südöstlichen China' and shortly afterwards changed the spelling of his name to F. Kolbeck, with the result that he appears in catalogues as two individuals. In 1884 he went to Freiberg as assistant, becoming professor of assaying and blowpipe analysis in 1896, and in 1901 succeeding A. Weisbach as professor of mineralogy, from which post he retired in 1928. He was an expert worker with the blowpipe; and he improved and increased the extensive mineral collection in the Mining Academy. Weisbach's text-books were kept up to date: 'Tabellen zur Bestimmung der Mineralien', 6th to 13th editions (1902–24), and 'Synopsis Mineralogica', 4th edition (1906). In new editions of C. F. Plattner's 'Probierkunst mit dem Löthrohre' (7th and 8th editions, 1907 and 1927) he gave the name weisbachite for a barium-bearing variety of anglesite. In his relatively few papers records are given of German occurrences of the less common minerals argyrodite, barytocalcite, childrenite, euclase, phenakite, and samsonite. Kolbeckite,

named after him, is a rare silico-phosphate of aluminium and beryllium; and later, another of his pupils gave the name kolbeckine for tin sulphide (SnS) from Bolivia, which has since been re-named herzenbergite.

S. von Gliszczynski, Neues Jahrb. Min. Monatshefte, Abt. A, 1943, pp. 59–63, with portrait and bibliography. R. Schreiter, Min. Petr. Mitt. (Tschermak), 1943, vol. 55, pp. 271–273.

Kolderup (Carl Fredrik) [1869–1942], Norwegian geologist, was born at Bergen on December 6, 1869, and died there on November 1, 1942. A pupil of W. C. Brøgger in Oslo, he entered in 1896 the Bergen museum, where he developed an excellent department of mineralogy and geology, of which he was appointed professor in 1914, retiring in 1939, and being succeeded by his son Niel Henrik Kolderup. He founded a seismological institute and was also director of the whole museum from which he developed the University of Bergen. His first paper in 1896 and several later ones were on the anorthosites (labradorfels) of western Norway and associated rocks, to some of which he applied the names andesinfels, birkremite, farsundite, ilmenitite, mangerite, and soggendalite.

T. F. W. Barth, Årbok Norske Videnskaps-Akad., 1944, for 1943, pp. 59–66, with portrait and bibliography. A. Kvale, Norsk Geol. Tidssk., 1945, vol. 24, pp. 1–13, with portrait and bibliography. V. M. Goldschmidt, Quart. Journ. Geol. Soc. London, 1945, vol. 100 (for 1944), pp. lvi–lviii.

Kreutz (Stefan) [1883–1941], Professor of Mineralogy in the University of Cracow (Kraków), was born on June 6, 1883, at Lemberg (Lwów), Poland, the son of Felix (— Szczęsny) Kreutz, who had also been professor of mineralogy at Cracow [Min. Mag. **16**–158]. Together with many other members of the university he was ruthlessly exterminated by the barbarian invaders. After graduating at Vienna (Wien) under F. Becke, he worked in 1908 at Oxford under H. A. Miers on the parallel growth of crystals of sodium nitrate on barytocalcite, his results being published in this Magazine (vol. 16). Afterwards he was assistant to J. Morozewicz (q.v.), then professor of mineralogy at Cracow, whom he succeeded in 1919. Early papers (from 1907) were on twinned crystals of calcite from various localities including Cumberland, the relationship between the optical data and the chemical composition of the amphibole group, and on alstonite. Later papers dealt with Polish minerals and rocks, and, following his father, on the fluorescence of minerals. He was a member of this Society since 1926.

Krieger (Philip) [1900–40], Assistant Professor of Economic Geology in Columbia University, New York City, was born at Portland,

Oregon, on November 22, 1900, and was killed in a motor-car accident on August 18, 1940, when returning from a visit to his wife and one-year-old daughter at their summer home. His parents had emigrated from the Ukraine, being descendants of a Bavarian colony that had settled there about 1690. After some mining work in Alaska, he entered Oregon State College, and after graduation was a mining engineer in Mexico. In 1928 he went to Columbia University as a graduate student and assistant, becoming assistant professor in 1935. His few published papers gave much promise for future work. The first, in 1930 [M.A. 4–274], gave X-ray, optical, and density data for a series of seven specimens ranging in composition from calcite to rhodochrosite. Other papers described Mexican occurrences of uraninite with gold, strontianite, klaprothite in bornite, primary native silver, &c., and the microscopical study of polished ore specimens.

P. F. Kerr, Amer. Min., 1941, vol. 26, pp. 178–181, with portrait and bibliography. C. P. Berkey, Proc. Geol. Soc. Amer., 1944, for 1943, pp. 177–181, with portrait and bibliography.

Kulik (Leonid Alekseevich) Кулик (Леонид Алексеевич) [1883–1942], scientific secretary to the committee on meteorites of the Russian Academy of Sciences, was born at Dorpat (= Tartu) in Estonia on August 19, 1883, and as a soldier died a wounded prisoner of war on April 14, 1942. He studied at Kazan University and in 1912 was assistant in the geological and mineralogical museum of the Academy of Sciences. His first work on meteorites was in 1918 when he gave an account of the Kashin (= Glazatovo) fall of that year. In 1919–20 he was teacher of mineralogy at Tomsk University, returning to the Academy of Sciences in 1921, when he was sent to Siberia to collect meteorites. But it was not until 1927–28 that he located and visited the place of the enormous explosion that happened on June 30, 1908, near the Podkamennaya (Stony) Tunguska river. A fourth expedition was made there in 1929–30 when he spent twenty months on the spot, but he failed to find any actual meteoritic material. He described many U.S.S.R. meteorites and gave lists of those in the Academy's collection.

E. L. Krinov, Природа [Nature], Acad. Sci. U.S.S.R., 1946, no. 9, pp. 85–87, with portrait.

Kurnakov (Nikolai Semenovich) Курнаков (Николай Семенович) [1860–1941], Russian chemist, was born at Nolinsk, Viatka government, on December 6 (old style November 24), 1860, and died on March 19,

1941. Graduating in 1882 at the Mining Institute in St. Petersburg, he there became lecturer and in 1893 professor of chemistry. Since 1902 he was professor of general chemistry at the Polytechnic Institute in St. Petersburg. In the Academy of Sciences he founded the Physico-chemical Institute and was director of the Platinum Institute. With a new form of recording pyrometer much work was done on the thermal analysis of alloys, salts, ores, and minerals. In connexion with work on the development of Russian salt deposits, including potash salts at Solikamsk [M.A. 2–128], he gave the name sakiite; and kurnakovite was named after him.

G. G. Urazov, Ann. Inst. Anal. Phys.-chem. Acad. Sci. URSS, 1941, vol. 14, pp. 9–14, with portrait; M. I. Ravich, ibid., pp. 113–124; E. Y. Rode, ibid., pp. 125–140. H. V. A. Briscoe, Nature, London, 1941, vol. 148, p. 310; S. I. Tomkeieff, ibid., 1944, vol. 154, pp. 582–583.

Levinson-Lessing (Frantz Yulievich) Левинсон-Лессинг (Франц Юльевич) [1861–1939], Russian petrologist, was born at St. Petersburg on March 9 (February 25, old style), 1861, and died there in the night of October 24–25, 1939. Writing in German his name appeared as F. Loewinson-Lessing; other variations are Löwinson- and Loevinson-, and, for Юльевич, Юліевич, Юлиевич, Julievič, Julievitch, Juliewitsch, Júljewitsch, Youlievich. After graduating in 1883 at the University of St. Petersburg he was assistant there in geology, and in 1892 was appointed professor of mineralogy and geology in the University of Dorpat (= Yuriev = Jurjew = Tartu) in Estonia. From 1902 to 1930 he was professor of geology, petrology, and mineralogy in the new Polytechnic Institute at St. Petersburg, and from 1920 also professor in the university. In 1925 he was elected a member of the Russian Academy of Sciences and director of the Geological Museum and Petrographical Institute of the Academy. His first paper in 1884 on diabase from Olonetz was followed by more than 200 papers and books dealing with the petrography of the Caucasus, Urals, and other areas in Russia and Siberia, with petrogenesis, classification, nomenclature, history, &c.

F. Y. LEVINSON-LESSING

A chemical classification of eruptive rocks was based on the 'acidity coefficient', and non-silicate magmas were also included. A very useful book of reference is his 'Petrographisches Lexikon' first published in German (Jurjew, 1893–98), followed by a French edition published by the International Geological Congress (Paris, 1900) and two Russian editions (1932, 1937). Text-books were also written on petrology (four editions, 1925–38), crystallography (1911), and general geology (1923), and tables for the determination of rock-forming minerals (five editions, 1891–1933, and English translation, 1893). 'The petrography of U.S.S.R.' edited by him was planned to extend to 31 volumes [M.A. **6**–242]. He gave only few new rock names, these being mostly obvious names for monomineralic rocks, and he considered some names given by other authors to be unnecessary. A few papers were written on mineralogy and meteorites, and he is responsible for the mineral name pseudopyrophyllite. A cerium mineral from the Urals has been named lessingite after him.

Portraits and bibliographies in two volumes (1915 and 1934) dedicated to him on the completion of 30 and 50 years of scientific and teaching work. Soviet Geology, 1939, vol. 9, Oct.–Nov. no., pp. 133–135. N. Eliseev, Mém. Soc. Russe Min., 1939, ser. 2, vol. 68, pp. 529–532, with portrait. P. I. Lebedev, Vestnik Akad. Sci. USSR, 1940, pp. 138–144, with portrait. B. M. Kupletsky, Bull. Acad. Sci. URSS, Sér. Géol., 1940, no. 2, pp. 3–24, with portrait and bibliography. L. S. Berg, Izvestia Soc. Russe Géogr. URSS, 1940, vol. 72, pp. 77–81, with portrait. S. I. Tomkeieff, Nature, London, 1939, vol. 144, pp. 1005–1006; Quart. Journ. Geol. Soc. London, 1940, vol. 96, pp. lxiv–lxvi. W. Loutchinsky, Bull. Soc. Franç. Min., 1939, vol. 62, pp. 281–282. V. I. Vlodavetz, Bull. Kamchatka Volc. Sta., 1940, no. 8, pp. 5–6. J. Ginsburg [I. I. Ginzburg], Zentralbl. Min., Abt. A, 1940, pp. 103–104. S. J. Shand, Proc. Geol. Soc. Amer., 1941, for 1940, pp. 227–228, with portrait and selected bibliography. N. M. Asafova and O. V. Isakova, Bibliography, 1884–1940 [325 entries], Acad. Sci. Moscow, 1941.

Lincio (Gabriele) [1874–1938], a roaming Italian mineralogist, was born at Varzo in Piedmont and died there on July 26, 1938. After study in 1893–94 at the University of Torino (Turin), he went to the Mining Academy at Freiberg in Saxony, gaining the diploma of metallurgical engineer in 1898. Then he studied mineralogy under P. Groth at München, and for two years was private docent and curator of the mineral collection at the Mining Academy at Clausthal in the Harz. Next he went to Heidelberg to study crystallography under V. Goldschmidt, and afterwards took the degree of doctor at the University of Marburg. Returning to Italy, he was for a short time at Roma on the Italian Geological Survey. But in 1905–6 he was back again in

Germany as scientific director of the firm of Leitz at Wetzlar for the design of mineralogical and petrographical microscopes. Returning again to Italy he was successively docent in mineralogy at the universities of Torino (1909), Cagliari in Sardinia (1913), Modena, and Genova (1925), at the last two eventually becoming professor and director of the mineralogical institute. His first paper in 1903 was on the crystallography of quartz, and later papers dealt with the growth and corrosion of quartz, including artificial crystals, and the optical properties. Occurrences of Italian minerals and rocks were described.

A. Pelloux, Atti Soc. Sci. Lett. Genova, 1939, vol. 4, pp. 45–50, with bibliography (51 items).

Lindgren (Waldemar) [1860–1939], Emeritus Professor of Economic Geology in the Massachusetts Institute of Technology, was born at Kalmar in Sweden on February 14, 1860, and died at Brighton in Massachusetts on November 3, 1939. For five years (1878–83) he studied at the Mining Academy at Freiberg in Saxony, graduating as mining engineer. In 1883 he migrated to America and was an assistant geologist on the Northern Transcontinental Survey, and in 1884 was transferred to the United States Geological Survey, eventually becoming Chief Geologist, and retiring in 1912 to be Head of the Department of Geology in the Massachusetts Institute of Technology, which post he held until 1933. His earliest papers, published in Swedish, were on the arsenate minerals mimetite, berzeliite, and karyinite from Långban: in 1881 he described a double-refracting form of berzeliite which in 1884 he named pseudoberzeliite. In America followed a constant stream of papers and monographs on the geology and ore-deposits in the western states, and afterwards on those of Bolivia. He did pioneer work in clarifying theories of the genesis and the classification of ore-deposits in relation to the associated rocks, zoning of deposits, and the paragenesis of their minerals. His standard text-book 'Mineral deposits' (1913) passed through four editions. The useful annual volumes 'Annotated bibliography of economic geology' were inaugurated by him in 1929 and he was the mainstay in their production. In addition to pseudoberzeliite, other new minerals which he described were morencite, coronadite, melanovanadite, and violarite. Lindgrenite ($2CuMoO_4.Cu(OH)_2$) was named after him. He was president of the 16th International Geological Congress held in Washington in 1933, president of the Geological Society of America in 1924, and first president of the

Society of Economic Geologists. The Wollaston Medal of the Geological Society of London was awarded to him in 1937.

L. C. Graton, Life and scientific work of Waldemar Lindgren. Ore deposits of the western states, Amer. Inst. Mining & Metall. Engineers, Lindgren volume, 1933, pp. xiii–xxxii, with portrait and bibliography [M.A. 6–3]. L. C. Graton, Econ. Geol., 1939, vol. 34, pp. 850 a–f. W. H. Newhouse, Science, New York, 1939, vol. 90, pp. 584–585. T. H. Holland, Nature, London, 1939, vol. 144, pp. 1083–1084. M. J. Buerger, Amer. Min., 1940, vol. 25, pp. 184–188, with portrait. P. Ramdohr, Zeits. Prakt. Geol., 1939, vol. 47, p. 187. H. Schneiderhöhn, Zentralbl. Min., Abt. A, 1940, pp. 65–69, with portrait. C. P. B[erkey], Quart. Journ. Geol. Soc. London, 1942, vol. 97 (for 1941), pp. lxxviii–lxxix.

Maufe, formerly Muff (Herbert Brantwood) [1879–1946], formerly Director of the Geological Survey of Southern Rhodesia, was born at Ilkley, Yorkshire, on August 27, 1879, and died suddenly in London on May 8, 1946. As a small boy he went with my sisters to a German kindergarten in Bradford and a few years later I showed him how to collect fossils on the Yorkshire coast. After graduating at Cambridge in 1901 he joined the Geological Survey and worked at mapping in Scotland and for a period also in Ireland. During 1905–6 he did geological surveying in British East Africa for the Colonial Office. He retired from the British survey in 1910 on his appointment as the first director of the Geological Survey of Southern Rhodesia, retiring in 1935 but still helping with the work. Up to the middle of 1909 he retained the name Muff. Early papers, the first in 1896 at the age of 17, were on glacial geology. He collaborated in the production of several classical memoirs of the Scottish survey, and in Southern Rhodesia many reports and bulletins were issued which had a direct influence on the greatly increased production of economic minerals in the country. Maufite, named after him, is a nickel-bearing aluminium silicate from Southern Rhodesia.

E. B. Bailey, Nature, London, 1946, vol. 157, pp. 865–866.

Miers (*Sir* Henry Alexander) [1858–1942]. *See* Min. Mag., 1944, vol. 27, pp. 17–28, with portrait and bibliography.

Millosevich (Frederico) [1875–1942], Professor of Mineralogy in the University of Roma, was born at Venezia (Venice) on January 10, 1875, and died at Roma on November 8, 1942. Graduating at Roma in 1896, he was an assistant there under G. Struever and later professor of mineralogy at the University of Sassari in Sardinia (1906) and at Firenze

(1908), succeeding G. Struever at Roma in 1915. His first paper, in 1898, on the crystallography of some organic compounds was followed by many others on Italian minerals and rocks, especially those from Sardinia. The Uegit meteorite was described in 1924, and he issued a catalogue of the meteorites in the collection of the University of Roma. Mineral names he proposed are cobaltocalcite and paternoite; and millosevichite was named after him. In 1930 he founded the 'Periodico di Mineralogia' which he directed until the time of his death. He was Rector of the University of Roma (1927–30), Senatore del Regio since 1928, president of the R. Accademia dei Lincei (1938), and afterwards vice-president when this was amalgamated with the R. Accademia d'Italia.

E. Onorato, Periodico Min., 1943, vol. 13, pp. 245–253, with portrait and bibliography.

Molengraaff (Gustaaf Adolf Frederik) [1860–1942], Dutch geologist, was born at Nijmeden, on February 27, 1860, and died at Wassenaar on March 26, 1942. He was successively professor of geology and mineralogy in the University of Amsterdam (1891–97), State geologist of the South African Republic, Transvaal (1897–1902), consulting geologist in Johannesburg (1902–5), and secretary and president of the Geological Society of South Africa, and professor of geology in the Technical High School at Delft (1906–30). Extensive explorations were undertaken in the Dutch East Indies and the Dutch West Indies, and pioneer work was done in Transvaal. His first papers, representing work done under P. Groth in München in 1888–89, were on the crystallography of volcanic sulphur from the West Indies, and elaborate studies on the natural and artificial etch-figures on quartz crystals. Various South African minerals were described both before and after his appointment as State geologist. Molengraaffite from Transvaal, named after him, has recently been shown to be identical with lamprophyllite. He was an honorary fellow of the Geological Society of London and was awarded the Wollaston medal in 1936.

H. A. Brouwer, Jaarboek Nederland. Akad. Wetensch., 1942, for 1941–42, pp. 135–191, with portrait. A. L. du T[oit], Quart. Journ. Geol. Soc. London, 1944, vol. 99 (for 1943), pp. lxxvii–lxxviii. Bull. Soc. Belge Géol. Bruxelles, 1943, vol. 52, pp. 259–260. S. J. Shand, Proc. Geol. Soc. Amer., 1944, for 1943, pp. 205–206, with portrait and selected bibliography.

Morozewicz (Jóssip Marian, *later* Józef) [1865–1942], Director of the Geological Survey of Poland, was born at Rzędziany village, Lomza

govt., Poland, on March 27 (old style March 19), 1865. After graduating at the University of Warsaw (Warszawa) he was an assistant there from 1889 to 1893, and then curator of the mineralogical museum. Later he was a geologist on the Russian Geological Survey (1897–1905), professor of mineralogy in the University of Cracow (Kraków) (1905–19), and since 1919 director of the Geological Survey of Poland.

Early work in Warsaw was on the experimental production of rocks and minerals (corundum, spinel, sillimanite, haüyne, lagoriolite or soda-garnet, &c.) by melting in the glass-furnaces large (1 cwt.) charges of silicate mixtures rich in alumina. The final results were collected as a dissertation published in Russian in 1897 (246 pp.) and afterwards in German [Min. Mag. **12**–313]. Petrographical work was also done on Polish rocks. During the second period monographs were produced on various districts in the Ural Mountains, including the iron-ores of Mount Magnitnaya and the corundum-bearing rock (kyshtymite) of Kyshtym; in the south of Russia at Mariupol and Taganrog, on the Sea of Azov, on alkalic rocks including a new type which he named mariupolite, and a new rare-earth mineral beckelite; and in 1903 in the Commander Islands, Bering Sea, where native copper and a new zeolite, stellerite, were found [M.A. **3**–28]. Then at Cracow, Polish minerals were described, including several new species or varieties. Finally, at Warsaw, papers were written on iron-alkali amphiboles (tamarite), the chemical composition of nepheline, &c. Polish editions of G. Tschermak's text-book on mineralogy were published in 1900 and 1931, the latter with many additions (887 pp.).

Nikitin (Vasilii Vasilievich) Никитин (Василий Васильевич) [1867–1942], Russian geologist, was born at St. Petersburg on March 18, 1867, and died at Ljubljana in Slovenia, Yugoslavia (formerly Laibach in Carniola, Austria), on February 8, 1942. Writing in German he appeared as W. W. Nikitin. After study at the University of St. Petersburg he entered in 1890 the Institute of Mines at St. Petersburg as pupil and assistant of E. S. Fedorov, later becoming professor of mineralogy, and he was also on the staff of the Russian Geological Survey. For a time he was professor of pedology (soil science) in the University of Perm, and since about 1928 professor of mineralogy, petrology, and ore-deposits at the University of Ljubljana. He wrote large monographs on the Uralian mining districts of Bogoslovsk (with E. S. Fedorov), Verkh-Isetsk, &c. But he is best known for his exposition of the Fedorov method of determining the optical properties of crystals in

thin slices on the universal microscope stage, and for his determination of the optical constants of the plagioclase felspars [M.A. **5**–364]. On this subject he wrote two books, one of which was translated into French (1914), and the other was written in German [M.A. **6**–433].

M. Gysin and V. Kovenko, Schweiz. Min. Petr. Mitt., 1942, vol. 22, pp. 367–369, with portrait.

R. NOVÁČEK

Nováček (Radim) [1905–42], Czech mineralogist, was born at Ústí nad Orlicí on March 21, 1905, and died in the German concentration camp of Mauthausen on February 13, 1942. He studied natural sciences and chemistry at the Charles University of Praha, where since 1927 he was assistant and since 1936 docent in mineralogy. Detailed studies were made on the garnets of pegmatites and some other Czechoslovak minerals; also on secondary uranium minerals, of which jachymovite and $\beta$-uranotile were described as new species.

V. Čech, Věstník Státního Geol. Ústavu Republiky Československé, 1946, vol. 20 (for 1945), pp. 23–25, with portrait and bibliography.

Oates (Frank) [1890–1945], chief geologist on the Survey of Tanganyika Territory, was born at Epsom in Surrey on February 10, 1890, and died on June 10, 1945, a few days after his return to England on retirement owing to illness. His course (1913–14, 1919–21) at the Royal School of Mines, London, was interrupted by the war. In 1924 he was appointed an assistant on the Geological Survey of the Gold Coast, and in 1929 chemist and petrologist on the survey of Tanganyika Territory, becoming chief geologist in 1943. In addition to official publications of the survey (including a useful account of the mineral resources), he also wrote on the few meteorites known from Tanganyika Territory, including the 12–15-ton mass of Mbosi [M.A. **8**–373].

Portrait in Bull. Geol. Div. Tanganyika Terr., 1946, no. 16.

Oliveira (Euzebio Paulo de) [1882–1939], Director of the Geological Survey of Brazil, was born at Areado, Abêté, Minas Geraes, on August 14, 1882, and died at his home at Copacabanca, Rio de Janeiro, on

October 12, 1939. After graduating at the School of Mines in Ouro Preto, he was appointed in 1906 engineer to the Coal Commission of Brazil, and in 1910 joined the Serviço Geológico e Mineralógico do Brasil under O. A. Derby, becoming deputy director in 1922 and director in 1925. He wrote many reports on the mineral resources of Brazil and gave a good collected account of all the known Brazilian meteorites [M.A. **5**–14].

Annaes Acad. Brasileira Sci., 1939, vol. 11, pp. 357–398, with portrait and bibliography (139 items); M. Doello-Jurado, ibid., 1940, vol. 12, pp. 241–242. Rev. Brasileira Geogr., 1940, vol. 2, pp. 53–55, with portrait. A. S. W[oodward], Quart. Journ. Geol. Soc. London, 1940, vol. 96, p. lxvi. Mineração e Metalurgia, Rio de Janeiro, 1939, vol. 4, pp. 189–194, 212, with portrait.

Partridge (Francis Chamberlain) [1903–39], a promising South African mineralogist, was born at Cape Town on November 23, 1903, and died at Pretoria on July 28, 1939, at the early age of 35 years. He graduated in chemistry and geology at the University of Cape Town and in 1926 was appointed mineralogist to the Geological Survey of South Africa. In 1929 he determined and described arandisite, an interesting tin silicate from South-West Africa. Several other good papers were produced, but much of his work remained unfinished; that on trevorite and a new nickel silicate allied to talc was published in 1944. Partridgeite, $(Mn,Fe)_2O_3$ [M.A. **9**–4, 5, 38], has been named after him.

Peck (Albert Becker) [1892–1943], Professor of Mineralogy in the University of Michigan, was born at Syracuse, New York, on September 19, 1892, and died suddenly from a heart attack on February 13, 1943. After studying at the Universities of Syracuse and Michigan, he was in 1914 assistant in mineralogy in the University of Michigan at Ann Arbor. For a time he was in charge of petrographical investigations in the Division of Ceramics of the United States Bureau of Standards, returning to the University of Michigan as assistant professor in 1920 and becoming professor in 1942. His work related mainly to ceramic materials, with applications of andalusite, kyanite, sillimanite, and dumortierite. Earlier mineralogical papers were in collaboration with E. H. Kraus. He had served as treasurer and secretary of the Mineralogical Society of America.

W. F. Hunt, Amer. Min., 1944, vol. 29, pp. 121–125, with portrait and bibliography.

Platnauer (Henry Maurice) [1857–1939] was born in London and died in Oxford on October 1, 1939. He studied at the Royal School of Mines in 1877–80, gaining the Murchison medal in geology and the Edward Forbes medal in biology. In 1880–83 he was an assistant in the Mineral Department of the British Museum and helped in the removal from Bloomsbury to South Kensington. He joined this Society in 1881, serving on the Council in 1882–85, and resigned in 1902. From 1884 to 1912 he was curator of the York Museum (Yorkshire Philosophical Society). He was the moving spirit in the foundation of the Museums Association in 1889, for many years acting as joint secretary and editor, and was president in 1911. His few publications include 'On the arrangement of rock collections in museums', a brief note on crystals of celestine from Yorkshire, and with E. Howarth the first 'Directory of museums' (1911).

Museums Journ., 1940, vol. 39, p. 482, with portrait.

Pollard (William) [1870–1946], formerly chemist on the Geological Survey of Great Britain, and a member of this Society since 1899, was born on April 30, 1870, and died at Chittlehamholt, Devon, on January 20, 1946. After studying at Cambridge, where he worked with A. Hutchinson on tetravalent lead, he went to Tübingen, taking his doctor's degree in 1894, and then returning to Cambridge. In 1898 he was appointed temporary assistant and in 1901 chemist on the Geological Survey. Unfortunately, owing to ill health, he was obliged to retire in 1913. He made many chemical analyses of minerals, rocks, and coals.

F. M. F. Thomas, Journ. Chem. Soc. London, 1946, pp. 759–760. A. F. H[allimond], Quart. Journ. Geol. Soc. London, 1946, vol. 102, p. xliii.

Pope (*Sir* William Jackson) [1870–1939], Professor of Chemistry in the University of Cambridge since 1908, was born in the City of London on March 31, 1870, and died at Cambridge on October 17, 1939. He was a pupil of H. E. Armstrong at the City and Guilds College at South Kensington, and there he attended the classes on crystallography given by H. A. Miers, under whose influence he very nearly became a mineralogist —in 1893 being an unsuccessful candidate for a post in the Mineral Department of the British Museum. However, he made good in crystallography, succeeding Miers as instructor, and emphasizing the importance of crystallography in chemistry. Crystals of many organic

compounds were measured goniometrically, especially enantiomorphous crystals showing optical activity (rotatory polarization) and their racemates and pseudo-racemates. New optically active compounds were prepared with N, S, Sn, and Se in asymmetric environments. Morphotropic relations were considered in relation to stereochemistry. In a series of papers (1906–10) in collaboration with W. Barlow a theory of valency-volumes was elaborated to correlate morphotropic relations with chemical constitution and crystal-structure, which has now been superseded by the results obtained by X-ray methods. A translation of A. Fock's 'Chemical crystallography' was issued in 1895. He was president of the Chemical Society in 1917–19, and was a member of our Society since 1891.

C. S. Gibson, Nature, London, 1939, vol. 144, pp. 810–812; Obituary Notices of Fellows of the Royal Society, 1941, vol. 3, pp. 291–324, with portrait; Journ. Roy. Soc. Arts, 1946, vol. 94, pp. 667–674, with portrait. G. T. Moody and W. H. Mills, Journ. Chem. Soc., 1941, pp. 697–715, with portrait. E. K. Rideal, Journ. Amer. Chem. Soc., 1940, vol. 62, pp. 1317–1318, with portrait.

Pratt (Joseph Hyde) [1870–1942], formerly State Mineralogist and Geologist of North Carolina, was born at Hartford, Connecticut, on February 3, 1870, and died at Chapel Hill, North Carolina, on June 2, 1942. He graduated in 1893 at Yale University, New Haven, Connecticut, and was assistant there, first in chemistry and afterwards in mineralogy. In 1892 he went with S. L. Penfield on a mineral-collecting trip in North Carolina, and in 1897 settled there as State mineralogist and later (1906–24) as State geologist. He was also lecturer in mineralogy (1898–1904) and professor of economic geology (1904–24) in the University of North Carolina. His resignation in 1924 was due to impaired health following service, as Colonel, in the war of 1914–18, but he continued work as a consulting engineer and geologist. During the period at Yale several good mineralogical papers were published, some in collaboration with S. L. Penfield or with H. W. Foote, including new species pirssonite and wellsite. Later he described minerals from North Carolina, including mitchellite and rhodolite as new, and particularly economic minerals and gemstones. His paper on the crystallography of ruby from North Carolina appeared in this Magazine (1899, vol. 12). As a member of the staff of the United States Geological Survey he contributed many articles to the annual volumes of 'Mineral resources'.

J. L. Stuckey, Amer. Min., 1943, vol. 28, pp. 155–166, with portrait and bibliography of 231 entries; Proc. Geol. Soc. Amer., 1943, for 1942, pp. 201–215, with portrait and bibliography.

Raisin (Catherine Alice) [1855–1945], a pioneer woman geologist, was born in London on April 24, 1855, and died in Cheltenham on July 12, 1945, at the age of ninety. She had been a life member of this Society since 1908, and was a member of the Geologists' Association for 67 years. She entered University College, London, in 1873 and later was honorary research assistant to Professor T. G. Bonney (1833–1923), with whom she collaborated in some publications. In 1890 she succeeded G. A. J. Cole (1859–1924) as head of the geology department at Bedford College for Women, retiring in 1920; from 1891 to 1908 she was also head of the botany department, and vice-principal of the college in 1898–1901. Her scientific work was on microscopic petrography, describing rocks, especially serpentines, from many regions.

D. L. Reynolds, Nature, London, 1945, vol. 156, pp. 327–328. L. H[awkes], Proc. Geol. Assoc. London, 1946, vol. 57, pp. 53–54. E. J. G[arwood], Quart. Journ. Geol. Soc. London, 1946, vol. 102, pp. xliv–xlv.

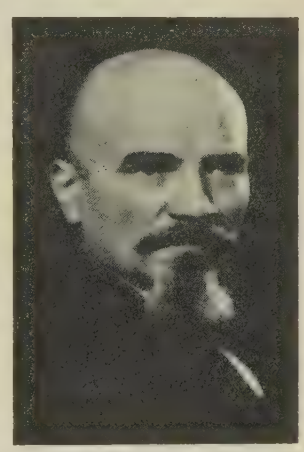
Rimann (Eberhard) [1882–1944] was born at Hirschberg, Silesia, on August 25, 1882, and died of cancer in 1944. A pupil of F. Zirkel at Leipzig, he was later private docent in mineralogy and geology in the Technical High School at Dresden, and engaged in geological mapping for a mining company in German South-West Africa. In 1912 he succeeded E. Hussak as mineralogist and petrographer on the Serviço Geológico e Mineralógico do Brasil. He returned to Dresden in 1920 as director of the mineralogical and geological museum in the Zwinger (now destroyed) and as professor in the Technical High School, retiring in 1943. He wrote on the mother rock of diamond in Brazil, and described kalkowskyn and bodenbenderite as new minerals.

Rogers (Arthur William) [1872–1946], formerly Director of the Geological Survey of the Union of South Africa, and a member of this Society since 1914, was born at Bishop's Hull, Somerset, on June 5, 1872, and died at Cape Town on June 23, 1946. After studying geology at Cambridge, where he was a scholar, and later an honorary fellow, of Christ's College, he was appointed in 1896 assistant geologist on the Geological Commission of Cape Colony, becoming director in 1903. From 1916 to 1932 he was director of the Geological Survey of the Union of South Africa. In recognition of his valuable work on the geology of South Africa he was awarded the Bigsby and Wollaston medals by the Geological Society of London. He was president

of the XVth International Geological Congress held in Pretoria in 1929.

A. L. du Toit, Nature, London, 1946, vol. 158, p. 407; Trans. Geol. Soc. South Africa, 1947, vol. 49 (for 1946), pp. 291–304, with portrait and bibliography; Proc. Geol. Soc. Amer., 1947, for 1946, pp. 209–215, with portrait and bibliography. Proc. Geol. Assoc. London, 1947, vol. 58, pp. 68–69.

Rosický (Vojtěch) [1880–1942], Czech mineralogist, was born at Praha on October 30, 1880, and died in the German concentration camp of Mauthausen on February 9, 1942. After studying at the Charles University at Praha, he was assistant there to Professor Karel Vrba, first in the National Museum and then in the University. Later (1907–8) he worked in the laboratories of P. Groth in München and of Victor Goldschmidt in Heidelberg. Returning to Praha he habilitated in 1909 as docent in mineralogy with a thesis on the crystallography of topaz from Japan, and in 1919 became professor of petrography. In 1921 he was appointed the first professor of mineralogy and petrography in the new Masaryk University at Brno in Moravia, where laboratories and collections were arranged. His first paper in 1901 and some later ones were petrographical, but his main work was on the detailed crystallography of several mineral species (topaz, miargyrite, tarbuttite, phenakite, &c.) and descriptions of new occurrences of minerals and rocks in Czechoslovakia.



V. ROSICKÝ

New models of instruments were designed—sclerometer, refractometer, and a two-circle goniometer for measuring large crystals weighing up to 1 kg. He wrote a text-book on morphological crystallography (1929), and a useful book on working methods in physical crystallography (1931). Another book on determinative mineralogy was published in 1939 after the German invasion and the closing and pillage of the Czech universities. His latest papers [M.A. **8**] were published in 1940–41 in a German periodical. The mineral names epidesmine, preslite, and ultrabasite are due to him; and rosickýite, named after him, is monoclinic $\gamma$-sulphur as a mineral.

Z. Jaroš, Sborník Klubu Přírodovědechéko v Brne, 1931, vol. 13, pp. I–VIII (for his 50th birthday). F. Slavík, Věda Přírodní, Praha, 1940, vol. 20, pp. 65–67

(for his 60th birthday); Praha (České Akad.), 1946, 24 pp. [Nature, London, 1947, vol. 160, p. 735.] J. Novák, Věstník Státního Geol. Ústavu Republiky Československé, 1946, vol. 20 (for 1945), pp. 6–9, with portrait.

Šimek (Antonín) [1887–1942] was born at Nové Hrady in Bohemia and died in the German concentration camp at Mauthausen. His first paper in 1909 dealt with the crystallography of sulphur from Serbia. Later he studied at Jena and Groningen, working with R. Marc on the thermal dissociation of $MgCO_3$, and with F. M. Jaeger on Li-Al silicates and liquid crystals. In 1919 he became professor of physical chemistry at the Masaryk University of Brno, where his work was on tellurium and $TeO_2$, and the content of rarer elements in Moravian minerals. With his wife, Hannah Šimeková, English text-books were translated into Czech, including W. H. Bragg's 'On the nature of things'.

G. Druce, Nature, London, 1943, vol. 152, p. 69.

Simpson (Edward Sydney) [1875–1939], Government Mineralogist and Analyst of Western Australia, was born at Sydney, New South Wales, on March 11, 1875, and died at South Perth on August 30, 1939.

E. S. SIMPSON (in 1935)

At the University of Sydney he gained many prizes and scholarships and graduated B.E. in mining and metallurgy. After acting as assayer to mining companies he was appointed, at the age of 22, mineralogist and chemist to the Geological Survey and Department of Mines of Western Australia, and in 1922 government mineralogist and analyst with charge of the combined Health, Agricultural, and Mines laboratories. He was one of the first students of the University of Western Australia and in 1919 took the D.Sc. degree with a thesis 'The minerals of Western Australia'. This was followed by a valuable series of annual 'Contributions to the mineralogy of Western Australia' (1926–38), and at the time of his sudden death he had in preparation a large book on the subject. Chemical analyses were made of many complex minerals containing niobium, tantalum, thorium, and uranium, amongst which were several new species and varieties—calciotantalite, hydrothorite, maitlandite, manganomossite, nicolayite, pilbarite, tantalopolycrase,

and tanteuxenite; while simpsonite (aluminium tantalate) was named after him. Other new minerals described were goongarrite, leucophosphite, and minyulite, while other names were given to various hypothetical end-members. Another line which he followed with enthusiasm was the recording of the meteorites of Western Australia and also of australites of which he described, perhaps rather rashly, two 'observed falls'. He did much towards the economic development of the mineral resources of the State, and served on many committees and public bodies. A useful book of reference is his 'Key to mineral groups, species and varieties' (1932). He was twice president of the Royal Society of Western Australia, in the founding of which in 1913 he took a part; his second presidential address was delivered only a month before his death and was printed afterwards [M.A. **8**–37]. He joined our Mineralogical Society in 1912 and contributed five papers to this Magazine. He was also a member of the American and French Mineralogical Societies.

Journ. and Proc. Australian Chemical Institute, September, 1939, vol. 6, pp. 345–347. Amer. Min., 1940, vol. 25, pp. 195–196.

Slavíková formerly Kaplanová (Ludmila) [1890–1943], Czech mineralogist, was born at Praha on February 23, 1890, and died in a German concentration camp at Rajsko (= Birkenau) in Poland on February 18, 1943. She studied at the Charles University in Praha, graduating Ph.D. with a crystallographic study on Bohemian pyrargyrite. In 1917 she married Professor František Slavík, and in that year published, in collaboration with him, a monograph on the structures and genesis of the Ordovician iron-ores of Bohemia [M.A. **1**]. Other papers dealt with the crystallography of some organic compounds, new occurrences of minerals in Czechoslovakia, a second mass of the Bohumilice meteorite, and historical notes on the mineral collection of the National Museum at the time of its centenary. From 1921 until 1939 she was keeper of minerals in the National Museum.

L. SLAVÍKOVÁ

K. Tuček, Věstník Státního Geol. Ústavu Republiky Československé, 1946, vol. 20 (for 1945), pp. 3–5, with portrait and bibliography.

Steiger (George) [1869–1944], formerly Chief Chemist of the United States Geological Survey, was born at Columbia, Pennsylvania, on May 17, 1869, and died at Washington, D.C., on April 18, 1944. He entered the survey as chemist in 1892, and as chief chemist (1916–30) he succeeded F. W. Clarke. He resigned from this post to leave himself freer for his own work, finally retiring in 1939. He collaborated with F. W. Clarke in experimental work on the constitution of mineral silicates and in the preparation of ammonium and silver substitution products of the zeolites. With E. S. Larsen he described sulphatic cancrinite and griffithite. Steigerite, named after him, is a hydrous aluminium vanadate.

J. J. Fahey, Amer. Min., 1945, vol. 30, pp. 153–156, with portrait and bibliography.

Suess (Franz Eduard) [1867–1941], Emeritus Professor of Geology in the University of Wien (Vienna), was born at Wien on October 7, 1867, and died there on January 26, 1941. His more distinguished father, Eduard Suess (1831–1914), was born in London and was also professor of geology at Wien. After graduating in 1891 at Wien, F. E. Suess was assistant for three years in the German Technical High School at Praha (Prag) in Bohemia, and for a short time in 1911 he returned there as extraordinary professor of geology. For several years (1895–1908) he was on the staff of the Austrian Geological Survey, where most of his work was on the crystalline rocks of Bohemia and Moravia. In 1896 he was also private docent for geology in the University of Wien, becoming extraordinary professor in 1905, ordinary professor in 1911, and retiring in 1937. A subject of special interest to him was that of the moldavites of Bohemia and Moravia and of similar natural glasses found sporadically in a few other parts of the world. He suggested in 1898 [Min. Mag. **12**–311] that these were of cosmic (meteoritic) origin, and in 1900 he gave for them the collective name of tektites. Another natural glass found as 'pumice' in a rock basin at Köfels, Oetz valley, Tirol, he named köfelsite, ascribing its origin to the fall of a large meteorite and giving an almost fantastic account of the rock basin as a meteorite crater [M.A. **6**–401]. A mineral name due to him is antiperthite to describe the intergrowth of orthoclase in a plagioclase host (perthite being an intergrowth of plagioclase in a potash-felspar host).

Festschrift F. E. Suess, Mitt. Geol. Gesell. Wien, 1937, vol. 29 (for 1936), with portrait. J. V. Harrison, Nature, London, 1942, vol. 150, p. 341.

Swift (Mansell James) [1854–1942], scientific instrument maker of the firm James Swift & Son of Tottenham Court Road, London, died on October 13, 1942, at the age of 88. His son, Mansell Powell John Swift (1885–1942), also an active member of the firm, died the previous day, October 12, at the age of 57. The firm was founded in 1852 by his father, James Powell Swift (1828–1905), who had served his apprenticeship with Messrs. Ross. Thomas Swift (1799–1882), of the preceding generation, assisted in the sale of microscopes in Australia. One of the many models was the 'Dick' microscope with rotating nicol prisms and fixed stage, which was made in 1888 [Min. Mag. **8**–160, **15**–335; see also **17**–87, **18**–56, **19**–96].

B. K. Johnson, Nature, London, 1942, vol. 150, p. 762.

Tarr (William Arthur) [1881–1939], Professor of Geology and Mineralogy in the University of Missouri at Columbia, was born at New Cambria, Missouri, on March 29, 1881, and died on July 28, 1939, after a long illness. After graduation at the Oklahoma Agricultural and Mechanical College, he further studied and acted as assistant in the Universities of Arizona and Chicago. In 1911 he was instructor in geology and mineralogy in the University of Missouri, becoming assistant professor in 1913 and full professor in 1919, also serving on the Missouri Bureau of Geology and Mines and as consulting geologist to various petroleum companies. He was a prolific author covering a wide range of subjects, being especially interested in concretions in sedimentary rocks, the origin of chert and flint, the lead-zinc and baryte deposits of Missouri, &c. His text-books are 'Introductory economic geology' (1930) and, with E. B. Branson, 'Introduction to geology' (1935). In 1924–25 he travelled and studied in Europe, when he became a member of this Society.

J. P. Connolly, Amer. Min., 1940, vol. 25, pp. 189–194, with portrait and bibliography. E. B. Branson, Proc. Geol. Soc. Amer., 1940, for 1939, pp. 241–247, with portrait and bibliography.

Thomson (Joseph Ellis) [1882–1944], Professor of Mineralogy in the University of Toronto, was born at Toronto on July 27, 1882, and died there very suddenly on September 26, 1944, only shortly after his appointment as head of the department. He was a member of this Society since 1926. Educated at the University of Toronto he further studied at Columbia University in New York, the Freiberg Mining

Academy, and Heidelberg and Harvard Universities. In 1912 he was appointed demonstrator in mineralogy at Toronto, becoming assistant professor in 1921, and head of the department in succession to A. L. Parsons in 1943. His first paper in 1917 on the crystallography of chessylite from Tsumeb, South-West Africa, was followed by another on phosgenite from the same locality, this work having been done in Heidelberg. He then turned over to the new method of examining polished sections of opaque minerals in reflected polarized light, which he continued to make his special study, examining many Canadian ore minerals. His papers appeared under the name of E. Thomson or Ellis Thomson, and have been confused in bibliographies with those of James Edgar Thomson, also of Toronto.

A. L. Parsons, Amer. Min., 1945, vol. 30, pp. 157–162, with portrait and bibliography. Univ. Toronto Studies, Geol. Ser., 1945, no. 49, p. 94, with portrait. H. C. Rickaby, Trans. Roy. Soc. Canada, 1945, ser. 3, vol. 39, Proc., pp. 123–124, with portrait. E. S. Moore, Proc. Geol. Soc. Amer., 1946, for 1945, pp. 271–273, with portrait and bibliography.

Ulrich (František) [1899–1941], Czech mineralogist, was born at Boharyně in eastern Bohemia on November 11, 1899, and was murdered by the German Gestapo on October 21, 1941. After studies in Praha and Oslo he became in 1928 docent and in 1934 professor of experimental mineralogy in the Charles University at Praha. There, in continuation of his work with V. M. Goldschmidt at Oslo, he organized an X-ray laboratory in the mineralogical institute. Many of his papers dealt with mineral occurrences in Czechoslovakia, particularly of phosphate minerals: 35 are noted in Min. Abstr., vols. 1–7. In collaboration with R. Jirkovský slavíkite was described as a new mineral. As secretary of the Czechoslovak Research Council he proved himself to be an excellent organizer.

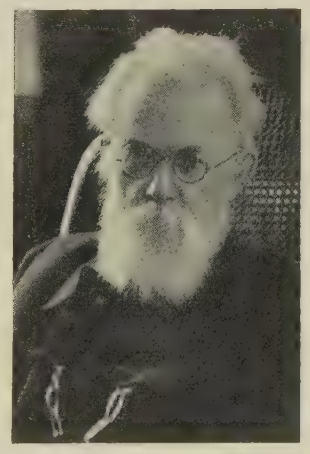
C. ULRICH

F. Fiala, Věstník Státního Geol. Ústavu Republiky Československé, 1946, vol. 20 (for 1945), pp. 10–22, with portrait and bibliography (191 items). G. Druce, Nature, London, 1945, vol. 156, p. 75.

VANDENDRIESSCHE (Adrien) [1914–40], Belgian mineralogist, was born at Menin on January 13, 1914, and as an artillery officer was killed in action at Ursel on May 27, 1940. He had worked under A. Schoep and V. Billiet (q.v.) at the University of Ghent (Gand). His first paper in 1935 gave a chemical analysis and age determination of pitchblende from Katanga. Other papers, in collaboration with V. Billiet, were on Belgian garnets and hydroxides of copper and cobalt from Katanga. A doctor dissertation presented in February 1940 on the petrography of metamorphic rocks of the Bastogne–Libramont region was published after his death. Vandendriesscheite, a hydrated uranate of lead from Katanga, was named in his memory in 1947.

Natuurwetensch. Tijdsch., 1940, vol. 22, p. 235; 1941, vol. 23, p. 61. Wetensch. Tijdingen, 1940, vol. 5, p. 204. A. Hacquaert, Natural science in Belgium during the war, Ghent, 1946, p. 106, with portrait. J. F. Vaes, Ann. (Bull.) Soc. Géol. Belgique, Liége, 1947, vol. 70, p. B 212.

VERNADSKY (Vladimir Ivanovich) Вернадский (Владимир Иванович) [1863–1945], Russian mineralogist and geochemist, was born on March 12 (February 28 old style), 1863, at St. Petersburg and died on January 6, 1945, at Moscow. In his published works his name often appeared as W. J. Vernadsky. After graduating at St. Petersburg University he was in 1886 assistant in Moscow University. Further study was done in 1888 at Munich under Groth, and in 1889–90 he worked in the laboratories of Fouqué, Le Chatelier, and Curie, at Paris. Returning to Moscow in 1891 as private docent, he was later (1898–1911) professor of mineralogy and crystallography, and pro-rector (1906–11) of the university. On his election to the Academy of Sciences in 1906 he had charge of the mineral collection of the academy, then in St. Petersburg. Later, on the removal of the academy to Moscow, he was director of the biogeochemical laboratory, of the radium institute, and of the meteorite committee. During the years 1923–25 he was visiting professor in the University of Paris, and he also lectured in Praha.



V. I. VERNADSKY

Apart from two short Russian papers on phosphates and soils, his

first mineralogical paper, published in France in 1889, was on the action of heat on kyanite. This led to an intensive study of alumino-silicates. Inquiries into the genesis of minerals led to his work on geochemistry with the publication of his book 'La géochemie' (Paris, 1924), of which there was a German and two Russian editions; and 'La biosphère' (1929) dealing with the formation of minerals by living organisms. Larger works, never completed, are his 'Essay on descriptive mineralogy' (vol. 1, 5 parts, 1908–14, on the elements; vol. 2, 1918–22) and 'History of minerals of the earth's crust' (vol. 1, 1925). Many kinds of gases were listed as minerals, and of natural waters, his 'largest group of minerals', he distinguished 553 species referred to 145 families (surely an excessive display of zeal!). Amongst the several mineral names he proposed, mendeleevite was named after his old teacher in chemistry, but it was never completely described. Vernadskite and vernadite were named after him.

Vernadsky was a most energetic and versatile worker, and he filled his pupils (among them Fersman) with his own degree of enthusiasm. He was simply bubbling over with bright ideas, which branching out so rapidly were never fully worked out or were soon abandoned.

Vernadsky jubilee volume (2 vols., 1936), with portrait and bibliography. D. P. Grigoriev, Vernadsky—the reformer of Russian mineralogy, Bull. Acad. Sci. URSS, Sér. Géol., 1944, no. 1, pp. 25–30, with portrait; V. I. Kryzhanovsky, Vernadsky as organizer of the mineralogical museum, ibid., pp. 31–34; V. A. Obruchev, ibid., 1945, no. 2, pp. 3–5, with portrait. A. E. Fersman, Bull. Soc. Nat. Moscou, 1946, n. ser., vol. 51, Sect. Géol., vol. 21, no. 1, pp. 53–61 (English summary, pp. 61–62); P. I. Lebedev, ibid., pp. 80–88 (English summary, pp. 88–89). Six articles by various authors, Mém. Soc. Russe Min., 1946, ser. 2, vol. 75, pp. 5–45, with portraits. B. L. Lichkov, Priroda, Acad. Sci. USSR, 1946, no. 3, pp. 78–83, with portrait. S. I. Tomkeieff, Nature, London, 1945, vol. 155, p. 296. T. M. Stadnichenko, Amer. Min., 1947, vol. 32, pp. 181–188, with portrait and bibliography. C. Maugin, Compt. Rend. Acad. Sci. Paris, 1945, vol. 221, pp. 157–161.

Walker (Thomas Leonard) [1867–1942], Emeritus Professor of Mineralogy and Petrography in the University of Toronto, was born near Brampton, Ontario, on December 30, 1867, and died after a long illness at Toronto on August 6, 1942. After graduating at Queen's University, Kingston, Ontario, in 1890 he worked in the Sudbury district, Ontario, with the Geological Survey of Canada and as chemist at the Murray mine, and was for two years demonstrator at Queen's University. In 1895 he was awarded one of the first 1851 Exhibition Scholarships and studied at Leipzig under F. Zirkel, taking the Ph.D. degree with a dissertation on the Sudbury nickel district, a subject to which he often returned. Later, he had also worked at crystallography

under V. Goldschmidt at Heidelberg. In 1897 he was appointed an assistant superintendent of the Geological Survey of India, where memoirs on the Vizagapatam and Kalahandi districts were prepared, and he also took part in a scientific expedition into Tibet. In 1901 he returned to Canada on his appointment as professor of mineralogy and petrography in the University of Toronto. In 1913 he was also appointed the first director of the Royal Ontario Museum of Mineralogy, which he developed to a wonderful degree, making it one of the most complete collections of minerals and one on which much research work was done. The results appeared as 'Contributions to Canadian mineralogy' and were published annually with unfailing regularity since 1921. To continue this good work the Walker Mineralogical Club was founded in 1938. During extensive collecting expeditions, especially in Canada, much material was obtained for the collection and for exchange with other museums. New minerals described were chapmanite, ellsworthite, genelectrite, ferrisymplesite, schoepite, spencerite, and temiskamite. He wrote a useful text-book on crystallography (1914) and reports on the tungsten and molybdenum ores of Canada. He was one of the founders of the Mineralogical Society of America in 1919 and its president in 1922. He was a member of our Society since 1913 and in 1937 was elected an honorary member. Walker was a good mixer and made many friends during his frequent visits to England and the sessions of the International Geological Congress.

T. L. WALKER (in 1937)

A. L. Parsons, Amer. Min., 1943, vol. 28, pp. 167–173, with portrait and bibliography; Proc. Geol. Soc. Amer., 1943, for 1942, pp. 241–249, with portrait and bibliography; Trans. Roy. Soc. Canada, 1943, ser. 3, vol. 37, Proc., pp. 91–93, with portrait. L. J. S[pencer], Quart. Journ. Geol. Soc. London, 1944, vol. 99 (for 1943), pp. xci–xcii.

Watts (William Whitehead) [1860–1947], Emeritus Professor of Geology in the Imperial College of Science and Technology, London, and President of this Society in 1924–27, was born at Broseley in Shropshire on June 7, 1860, and died at Sutton in Surrey on July 30, 1947. At Sidney Sussex College, Cambridge, he was encouraged to take geology

as his principal subject by J. F. Walker [Min. Mag. **14**–418, to whose help I also am indebted]. After graduating in 1881, he was appointed an extension lecturer (1882–91), and in 1888 acted as deputy professor of geology at Oxford. He joined the Geological Survey in 1891 as petrologist, first in charge of the collections of the Irish branch in Dublin, where he prepared a catalogue of the rocks, and in 1893 succeeding F. H. Hatch as petrologist in London, retiring in 1897 to become assistant professor of geology and geography at Mason College, Birmingham. In 1906 he succeeded J. W. Judd at the Royal College of Science, where he had the task of organizing the greatly enlarged department of geology, retiring in 1930.

W. W. WATTS

Many of his published papers, the first in 1882, dealt with the pre-Cambrian rocks of Shropshire and the Charnwood Forest in Leicestershire, and with other ancient rocks often in collaboration with his close friend Charles Lapworth. At the age of 85 he gave the first William Smith lecture to the Geological Society. But his main energies were devoted to teaching and organizing. He long served the Geological Society (president, 1910–12), and made a great success of its centenary celebrations in 1907, and of the jubilee of the Mineralogical Society in 1926. He was actively associated with the British Association, being president at the Norwich meeting in 1935, twice president of its geology section, and chairman of various committees including that of British geological photographs. Also twice president of the Geologists' Association.

Eminent living geologists, Geol. Mag., 1915, n. ser., dec. 6, vol. 2, pp. 481–487, with portrait and bibliography. P. G. H. Boswell, Nature, London, 1947, vol. 160, pp. 355–356.

Wells (Roger Clark) [1877–1944], Chief Chemist of the United States Geological Survey, was born at Peterboro, New York, on October 24, 1877, and died suddenly from a heart attack on April 19, 1944. He graduated at Harvard University where he was an instructor in analytical chemistry and worked with T. W. Richards on the atomic weights of sodium and chlorine. He joined the United States Geological

Survey as physical chemist in 1908, becoming chief chemist in 1930. Many mineral analyses were made, and in collaboration with other authors he described as new minerals brannerite, creedite, lorettoite, tungstenite, and uranothorianite. [The zeolite wellsite was named after H. L. Wells (1855–1924) of Yale University.]

W. T. Schaller, Amer. Min., 1945, vol. 30, pp. 163–168, with portrait and bibliography; Proc. Geol. Soc. Amer., 1946, for 1945, pp. 279–284, with portrait and bibliography.

Wolff (John Eliot) [1857–1940], Emeritus Professor of Petrography and Mineralogy in Harvard University, Cambridge, Massachusetts, was born at Montreal, Quebec, on November 21, 1857, and died on August 7, 1940. His father was Swiss and his mother a descendant of John Eliot (1604–90), the 'Apostle to the Indians'. He died in the Mojave Desert, California, while camping alone, his motor-car having got stuck in the sand. After graduating at Harvard University in 1879 he was engaged on various geological surveys; and in 1885–1904 was on the staff of the United States Geological Survey. Two years (1884–85) were spent with H. Rosenbusch in Heidelberg studying microscopical petrography; and later (1900) he spent a year with P. Groth in München. Returning to Harvard in 1887 he was instructor, later assistant professor, in petrography with optical mineralogy in the geology department, mineralogy at that time being taught in the chemistry department. A new department of mineralogy and petrography was inaugurated in 1895 with Wolff as head and as curator of the mineralogical museum. He retired in 1923 and was succeeded by Charles Palache. He did much for the improvement of the collection, often out of his private means, and he was instrumental in the acquisition of the valuable collection and endowment from A. F. Holden, of which he wrote an account in this Magazine (vol. 17, p. 117). The mapping of the Franklin Furnace district in New Jersey for the U.S. Geological Survey gave the opportunity of describing some of its minerals, including hardystonite as a new species, zinc-schefferite, native copper, &c. From Wyoming he described sheridanite as a new chlorite. But most of his work was petrographical and was continued in his new home at Pasadena, California. In 1938 (at the age of 81) he produced a long paper on the igneous rocks of the Crazy Mountains, Montana, on which he had been working since 1883 [M.A. 7–306]. He was president in 1934 of the Mineralogical Society of America.

C. Palache, Amer. Min., 1941, vol. 26, pp. 182–186, with portrait; Proc. Geol. Soc. Amer., 1941, for 1940, pp. 247–253, with portrait and bibliography.

Zemyatchensky (Petr Andreevich) Земятченский (Петр Андреевич) [1856–1942], formerly Professor of Mineralogy and Crystallography in the University of St. Petersburg, was born at Lipovka village in Tambov government on November 28 (old style Nov. 16), 1856, and died in Leningrad at the end of February 1942 in his 86th year. His name appeared in a variety of transliterated forms. Educated at the University of St. Petersburg, he became in 1883 curator of the mineral collection of the university, and was appointed ordinary professor in 1898, at first of mineralogy and later (1925–42) of soils. He was also professor in the Technological Institute, the Women's Medical Institute, and the Institute for Civil Engineering, and director (1919–42) of the Ceramic Institute. He wrote text-books on crystallography and mineralogy. A bibliography of his works from the year 1888 includes 88 items, six of which are for 1940 [M.A. **8**–161, 297]. In 1935 he produced a large volume on the clays of the U.S.S.R. [M.A. **6**–370]. A series of papers (1909–14) on crystallogenesis dealt with the influence of substances in solution on the crystalline form of alums and sodium chlorate. Several papers were on calcite deposits, and he made the first nicol prism from Russian material. The mineral names hydrogoethite, lardite, and silicomagnesiofluorite are due to him.

V. I. Vernadsky, Bull. Acad. Sci. URSS, Sér. Géol., 1943, no. 1, pp. 105–113, with bibliography.

K. ZIMÁNYI

Zimányi (Károly = Karl) [1862–1941], Hungarian mineralogist, was born at Budapest on March 2, 1862, and died on September 24, 1941. After study at the University of Budapest he was in 1884 assistant in mineralogy and geology under J. S. Krenner in the Polytechnic. In 1895 he was appointed assistant curator in the mineralogical and palaeontological department of the Hungarian National Museum (Magyar Nemzeti Múzeum), curator in 1902, director of the department in 1912, and of the Museum in 1922, retiring in 1932. In the department he succeeded J. S. Krenner (1839–1920) and was succeeded by V. Zsivny. Since 1888 he had written many papers, mostly on occurrences of Hungarian minerals and their crystal-

lography, which were illustrated with numerous excellent drawings of crystals. He was especially interested in the crystallography of pyrite which was dealt with in 18 of his 43 published papers. From 1922 until failing eyesight in 1929 he generously supplied abstracts of the Hungarian literature for this Magazine.

L. Tokody, Zentralbl. Min., Abt. A, 1942, pp. 34–39, with portrait; correction, p. 176. V. Zsivny, Földtani Közlöny, Budapest, 1942, vol. 72, pp. 1–17, 105–111, with portrait and bibliography.

# *Pyroxenes, amphibole, and mica from the Tiree marble.*[1]

(With Plate XIV.)

By A. F. Hallimond, M.A., Sc.D.

With chemical analyses by C. O. Harvey, B.Sc., A.R.C.S.

[Read March 27, 1947.]

## I. Introduction.

THE Tiree pink marble, a fine-grained, severely crushed limestone with evidence of earlier coarse crystallization, is exposed in several small areas up to 100 feet across on the farm of Balephetrish near the north coast of the island of Tiree in the Hebrides. It contains a remarkable quantity of dark silicate minerals and has discordant contacts with the adjacent Lewisian gneiss. The precise nature of its relation to the gneiss, and mode of emplacement, have been much discussed.[2] The writer has been permitted to consult accounts of the literature, by Mr. V. A. Eyles, and of the petrography, by Sir Edward B. Bailey, and is also indebted to those authors for discussion of the problems. At the suggestion of Sir Edward Bailey the present work was undertaken as a contribution to the study of this problem from the mineralogical point of view. Most of the determinations were made in 1938, but it was not possible to complete publication at that time.

Scattered somewhat evenly throughout the carbonate groundmass of the marble are numerous dark green crystalline patches which usually do not exceed half an inch across and are often much smaller; locally, however, there are pieces of dark gneiss-like rock of much larger size. The majority consist of pyroxene, sometimes accompanied by amphibole, &c., and the latter were regarded by Coomáraswámy and others as modified gneiss inclusions. Besides these assemblages the rock contains a subordinate amount belonging to other rock types, part of which may have been emplaced by the 'cold crush'; but many of these 'xenoliths', as is well known, are intergrown with uncrushed coarse calcite and must have been emplaced in the limestone at an earlier period, preceding the marmorization. For the present purpose attention

[1] Communicated by permission of the Director, Geological Survey and Museum.

[2] A. K. Coomáraswámy, Quart. Journ. Geol. Soc. London, 1903. vol. 59, p. 91.

has been confined to two hand-specimens of the predominant type, which were collected by Mr. V. A. Eyles; one representing the typical groundmass marble, with small scattered grains and groups of pyroxene; the other, a gneiss-like assemblage of pyroxene, amphibole, mica, and scapolite with coarse crystalline calcite. The dark minerals have been separated and their descriptions will be given below, with chemical analyses by Mr. C. O. Harvey. The silicates, except scapolite, are little altered, even the mica being apparently unaffected.

## II. Description of the analysed material.

### *A. Pyroxene marble.*

Locality: NE. end of shore section, Balephetrish, Tiree.

The hand-specimen shows dark pistachio-green pyroxene in a groundmass of pink porcellanous calcite. The grains, which form single crystals or aggregates, usually less than $\frac{1}{3}$ of an inch across, are rounded and polished (coccolite), but often have incomplete faces of the forms *a*, *b*, *m*, and are elongated along the *c*-axis. Locally the aggregates are larger.

*Microstructure.*—The thin section S32453 shows much pyroxene with *m* cleavage and in places numerous twin-lamellae parallel to *a*, also parting cracks parallel to *c*. When calcite has been included, in embayments or isolated patches, it has rounded outlines. The pyroxene forms isolated grains or groups intergrown with calcite in a typical coarse polyhedral granular texture (pflaster) in which the pyroxene is subidiomorphic (pl. XIV, fig. 1). The chip shows that the section has passed close to the side of a large pyroxene aggregate, which has no doubt protected the calcite from being crushed. A duplicate section (pl. XIV, fig. 2) was cut through typical groundmass marble, and this shows rounded pyroxenes in crushed calcite; some aggregates contain pyroxene, apatite, and an ophitic mineral of moderate birefringence, uniaxial negative, refractive index below balsam. This resembles mizzonite, but could not be completely identified and was not found in the tailing. Practically all the particles have their original outlines against coarse calcite in embayments, indicating that they were present before the 'cold crush'.

The first-mentioned section is crossed by a minute 'shatter-belt' of cleaved pyroxene fragments in a matrix of fine granular calcite. In places between the opened cleavages, and replacing the neighbouring calcite, is a minutely granular mineral of fairly low birefringence, refractive index 1·54, and lighter than bromoform. This is probably

chalcedony, introduced either at the time of the 'cold crush' or even later. There is no hornblende.

*Separation.*—The rock was crushed to pass 30 mesh to the inch and washed to remove fine dust. When stirred with dilute (1 in 5) acetic acid it effervesced freely. The insoluble part was dried and sieved, with further crushing and acid treatment. Finally the fraction 60–90 mesh was passed through a magnetic separator.[1] With full current the pyroxene was largely removed by the last magnet in a nearly pure state; the tailing consisted of small grains of pyroxene and a noticeable quantity of the granular silica, with a little apatite. After repeated magnetic treatment the concentrate was given a final wash with warm 1:4 hydrochloric acid and water and dried for analysis.

The density was determined in a specific gravity bottle, and the optical properties by means of the universal stage on a micro-section of the coarse separated grains mounted in plaster. $\beta$ for sodium-light was measured on flakes showing an optic axis (nearly normal to the *c* parting) in a liquid mixture which was checked by the Abbe refractometer. The results are summarized in table I.

### *B. Gneiss-like aggregates in calcite.*

Locality: Pink marble quarry, Balephetrish, Tiree.

The second hand-specimen represents a much less pure limestone, or calc-gneiss. Dark silicate grains up to $\frac{1}{3}$ of an inch across are scattered through fine-grained pale pink calcite, and towards one side there is an aggregate about 3 inches long of dark minerals mingled with calcite. Amphibole is present throughout along with more or less pyroxene, as polished grains which are often idiomorphic.

*Microstructure.*—The thin section S32451 and duplicates contain pyroxene, amphibole, biotite, altered scapolite, and calcite, with some apatite. The first two in places form composite aggregates up to 1 inch across. Calcite as included grains or embayments is coarsely crystalline and twinned, with rounded margins against the silicates, but the free calcite areas have been reduced to a fine granular condition. There is no chalcedony. The section shows a roughly banded arrangement, with pyroxene, or else amphibole and mica, predominating in different areas. The general texture of the aggregates is coarse polyhedral granular (pflaster) with subidiomorphic silicates (pl. XIV, figs. 4 and 5). The polyhedral boundaries are curved with a tendency to hexagonal outlines, a typical metamorphic texture which probably corresponds with pro-

[1] A. F. Hallimond, Min. Mag., 1930, vol. 22, pp. 377–381.

longed heating under conditions of physical and chemical equilibrium. In other places, however, the amphibole in particular has developed crystal outlines against the calcite and scapolite, or extends in irregular parallel growths often intergrown with biotite (pl. XIV, fig. 6). In places the outlines of the pyroxene suggest that it was being slowly absorbed while the amphibole and mica were increasing. The amphibole is occasionally in parallel growth with pyroxene, and the biotite often occurs with the basal plane parallel to the *a* face of the amphibole.

A distinctive arrangement of the minerals is the formation of narrow envelopes ('Schalen') surrounding the grains, the commonest example being a thin coating of scapolite surrounding amphibole in calcite (pl. XIV, fig. 3). The most probable cause seems to be a slow surface reaction under metamorphic conditions that led to the deposition of a single extended crystal; or the metamorphism of an existing altered surface. In pl. XIV, fig. 3 granules of pyroxene are included in the scapolite as if in a symplectite, but an envelope of pyroxene only was also seen, so this may indicate scapolitization of an original pyroxene envelope. Similar envelopes are an important feature in the Pargas limestone.[1]

The scapolite grains are nearly always polyhedral against silicates and calcite, and are probably not merely felspars replaced in situ. They are turbid from alteration to a micaceous mineral in parallel orientation. The bulk extinction and parting cracks are parallel with the elongation of the micaceous mineral, but the flakes are not all in one plane. Cleavage fragments in the tailing are roughly prismatic, and show a negative uniaxial interference-figure from areas of unaltered scapolite, emerging obliquely in the plane at right angles to the prism edges. This would agree with the development of the micaceous flakes along pyramidal planes of the scapolite, on which they confer a false cleavage. Both mica and scapolite have refractive index approx. 1·585 for vibrations parallel with the elongation of the flakes, i.e. approx. $\gamma$ in each case. This corresponds with about 60 % Me in the scapolite, a normal limestone value. Mr. C. O. Harvey reports on the fragments: 'The mineral contains aluminium as a major constituent, a little calcium, and some magnesium, almost certainly less than 5 % MgO. Alkalis not determined.' Talc or phlogopite seems to be indicated.

*Intergrowth of mica and pargasite.*—P. Quensel[2] has described an example from Almunge in which lepidomelane forms 'long thin lamellae

[1] A. Laitakari, Bull. Comm. Géol. Finlande, 1921, vol. 10, no. 54. [M.A. 1–211.]

[2] P. Quensel, Bull. Geol. Inst. Upsala, 1914, vol. 12, p. 146.

parallel to the cleavage planes' in ferrohastingsite which has reaction rims of drop-like diopside. At Mansjö, also, the pargasite is often intergrown with a dark phlogopite (table III); this mica is represented by the point 'new analysis 42' on the $R_2O_3/RO$ diagram for the biotite group (p. 239, below) and is intermediate in composition between true phlogopite and the Tiree mica. Quensel seems to imply that the Almunge mica was parallel to the *m* faces of the amphibole, but measurements on the universal stage indicate that at Tiree it is orientated parallel to the face *a*, the trace of the cleavage being parallel in the two minerals (pl. XIV, fig. 6).

*Separation.*—Part of the dark aggregate, with the omission of some surface-weathered material, was crushed to −30 mesh and cleaned with acid in the same way as the preceding. Mica was removed by rolling the powder down an inclined surface and by electrostatic separation. The powder was reduced to 90–120 and 120–180 mesh, again cleaned with acid, and passed through the magnetic separator. The pyroxene was ultimately obtained fairly pure, but the amphibole contained biotite and particles of pyroxene with inclusions. The tailing consisted of altered scapolite, pyroxene, and some apatite, but no silica. The mica was rolled with a glass rod to break up some grains of altered scapolite that had lifted, and then sieved and washed. The pyroxene and amphibole were finally purified by floatation in mixtures of methylene iodide with benzol or aniline (see note at the end of this paper). Densities were determined as before and the data are summarized in table I.

## III. Classification of the minerals.

The physical data agree with previous records for similar minerals, and the calculated atomic composition fulfils the requirements of the respective cell-formulae. When the present determinations were made, in 1938, it was difficult to complete the classification of the minerals because of the lack of summaries of the existing data. The new edition of Dana's 'System' is still in preparation, but in the interval several reviews of the mineral groups have been published, by means of which it has become easier to correlate the material. Reference will be made to these in the respective sections.

### *Diopside of normal marble* (Lab. no. 1037).

The physical data and analyses indicate a diopside nearer to the pure mineral than might perhaps be expected from the dark appearance in the hand-specimen. (Ca,Na) is very close to 1 atom; there is a small

TABLE I. Analyses[1] and physical data.

| | Pyroxene in calcite. | Pyroxene | Amphibole from a gneiss-like inclusion. | Biotite |
|---|---|---|---|---|
| Lab. no. | 1037 | 1038 | 1039 | 1040 |
| Slide no. | S32453 | | all from S32451 | |
| $SiO_2$ | 54·23 | 51·04 | 41·72 | 39·1 |
| $Al_2O_3$ | 1·84 | 4·74 | 15·86 | 17·6 |
| $Fe_2O_3$ | 0·92 | 1·85 | 3·36 | 1·1 |
| FeO | 1·98 | 2·79 | 6·03 | 6·8 |
| MgO | 16·02 | 14·77 | 14·14 | 18·7 |
| CaO | 24·02 | 23·64 | 12·92 | 1·2 |
| $Na_2O$ | 0·88 | 0·46 | 1·42 | 0·5 |
| $K_2O$ | 0·03 | 0·15 | 2·60 | 9·5 |
| $H_2O+105°$ | 0·04 | 0·16 | 0·85 | n.d. |
| $-105°$ | 0·05 | 0·09 | 0·04 | n.d. |
| $TiO_2$ | 0·14 | 0·39 | 0·81 | 1·9 |
| $P_2O_5$ | trace | trace | trace | trace |
| MnO | 0·23 | 0·17 | 0·12 | 0·1 |
| Cl | trace | trace | 0·46 | 0·3 |
| F | trace | trace | 0·16 | 0·2 |
| $Li_2O$ | 0·02 | trace | 0·02 | trace |
| BaO | n.d. | n.d. | n.d. | 0·5 |
| | 100·40 | 100·25 | 100·51 | 97·5† |
| Sp. gr. 20°/20° | 3·29 | 3·33 | 3·175 | 2·89 |
| $\alpha$ | *1·660** | 1·673 | 1·688 | 1·659 | 1·573 |
| $\beta$ | *1·668* | 1·679 | 1·694 | 1·668 | — |
| $\gamma$ | *1·690* | 1·699 | 1·711 | 1·677 | 1·618 |
| 2V | *65°* | 57°+ | 62°+ | 86° | — |
| $Bx_a:c$ | *40°* | 38° | 45° | 22° | — |
| Axial plane | (010) | (010) | (010) | (010) | — |
| Dispersion | r > v | r > v | slight | — |
| Colour in section | colourless | faint green | $\gamma$ bluish-green<br>$\beta$ yellow-green<br>$\alpha$ yellow | $\omega$ brown<br>$\epsilon$ pale straw |

* The data in italics were measured on the colourless diopside of the 'white marble', a neighbouring occurrence containing dolomite and forsterite, slide no. S24582. Optical determinations already made on similar but independent material by Sir E. Bailey were in close agreement with the present values throughout, and confirm the representative nature of the specimens; he points out that the data for the white marble diopside indicate the presence of $MgSiO_3$. The biotite is too much crushed to give a reliable axial angle.

† Analysis no. 1040 was carried out on a semi-micro scale and a reliable figure for water could not be obtained, owing to shortage of material.

replacement of Ca by Na, but no enstatite. A small content of Al is explained by the replacement $Al_2$/SiMg. The molecular ratio MgO:FeO exceeds 9:1, so that according to H. H. Hess[2] the mineral will be classed as *diopside*.

[1] Published in Summary of Progress for 1938 (Mem. Geol. Surv.), 1939, p. 94.

[2] H. H. Hess, Amer. Min., 1941, vol. 26, pp. 515–535 and 573 594. [M.A. 8–233.]

TABLE II. Analyses calculated to atomic ratios.

| | Pyroxene. | | Pyroxene. | | Amphibole. | | Biotite. | |
|---|---|---|---|---|---|---|---|---|
| Lab. no. ... ... | 1037 | | 1038 | | 1039 | | 1040 | |
| Si ... ... ... | 1·966 | 2·000 | 1·867 | 2·000 | 6·14 | 8·00 | 2·78 | 4·00 |
| Al ... ... ... | 0·034 | | 0·133 | | 1·86 | | 1·22 | |
| Al ... ... ... | 0·045 | | 0·071 | | 0·89 | | 0·26 | |
| Ti ... ... ... | 0·004 | | 0·011 | | 0·09 | | 0·10 | |
| Fe‴ ... ... ... | 0·025 | | 0·051 | | 0·37 | | 0·06 | |
| Li ... ... ... | 0·003 | 1·009 | — | 1·029 | 0·01 | 5·21 | — | 2·80 |
| Mg ... ... ... | 0·865 | | 0·805 | | 3·10 | | 1·98 | |
| Fe″ ... ... ... | 0·060 | | 0·086 | | 0·74 | | 0·40 | |
| Mn ... ... ... | 0·007 | | 0·005 | | 0·01 | | — | |
| Na ... ... ... | 0·062 | | 0·033 | | 0·40 | | 0·07 | |
| Ca ... ... ... | 0·932 | 0·995 | 0·926 | 0·966 | 2·04 | 2·93 | 0·09 | 1·02 |
| K ... ... ... | 0·001 | | 0·007 | | 0·49 | | 0·86 | |
| O ... ... ... | 5·990 | 6·000 | 5·961 | 6·000 | 22·98 | 24·00 | 11·00 | |
| OH ... ... ... | 0·010 | | 0·039 | | 0·83 | | $H_2O$, &c., | |
| F ... ... ... | — | | — | | 0·07 | | omitted | |
| Cl ... ... ... | — | | — | | 0·12 | | | |
| Vol. of cell containing[1] ... | 6O = 66·2 | | 6O = 66·0 | | 24O = 279 | | (12O) = 148 | |

*Fassaite of the aggregate* (Lab. no. 1038).

Here the proportion of Al is substantial. (Ca,Na) is still close to 1; there is, however, a deficiency of 0·034 which with the excess of 0·029 in the Mg group would imply the presence of a little enstatite. The ratio MgO:FeO is just over 9:1, so that the mineral would still be a diopside as defined by Hess. This classification, however, was devised mainly for igneous pyroxenes, and does not take into account the alumina content, which is probably the most important characteristic for the present minerals. C. E. Tilley[2] has given determinations of two aluminous pyroxenes from Ceylon and Monzoni, and proposes to employ the name fassaite for aluminous pyroxenes with a full content of Ca. These form a numerous and distinctive class. Accordingly, the present mineral may be placed as a member of the fassaite-diopside series (Al/Si 0·133 atom, O = 6) with an important proportion of *fassaite*, while the other pyroxene, described above, belongs to the same series, but is nearly pure diopside.

The optical data for the Monzoni fassaite were $\alpha$ 1·686 (1·688), $\beta$ 1·694 (1·694), $\gamma$ 1·712 (1·711), $\gamma:c = 43°$ (45°), sp. gr. 3·319 (3·33), $Al_2O_3$ % 7·61 (4·74). The physical values in brackets, for the present mineral, agree closely, but these data only confirm the opinion expressed by

[1] See A. F. Hallimond, Amer. Min., 1943, vol. 28, p. 77. [M.A. 9–270.]

[2] C. E. Tilley, Geol. Mag. London, 1938, vol. 75, pp. 81–86. [M.A. 7-181.]

Tilley: 'It is impossible to predict from physical data alone the tenor of alumina in hornfels pyroxenes.' The increase in refractive index over that of pure diopside is no doubt much influenced by the relatively small iron content. The Monzoni assemblage is pyroxene–spinel–calcite, and the present example, with a lower content of alumina, occurs in an assemblage of 'metasilicate' type, without either spinel or free silica.

The two Tiree pyroxenes bear some resemblance to those recorded by H. Eckermann from Mansjö.[1] Of the latter, that from 10 cm. within the limestone is richer in enstatite than no. 1037, and that next the igneous material higher in iron than no. 1038. The variation in MgO/FeO is, however, in the same sense at both localities, the limestone mineral being the more magnesian.

Another similar analysis is given by C. F. Davidson[2] for a diopside from a calcitic paragneiss at Rodil, South Harris. This is shown by Davidson to be similar to the *limestone* diopside from Tiree (not that from the 'xenolith'). It is associated with a pargasite which, apart from an unusually high content of CaO, generally resembles that from Tiree. None of the Harris minerals, however, contains as much iron and alumina as the corresponding ones from the Tiree gneiss-like aggregate, and the refractive indices and density fully confirm this disparity. A pargasite was also obtained from relatively pure limestone, and the two Harris amphiboles reflect the behaviour of the Tiree pyroxenes in that the one derived from the limestone has a lower content of iron and alumina. Davidson regards the paragneiss as a metamorphosed impure limestone, the sodium being possibly derived from a sodic clay constituent.

*Pargasite of the aggregate* (Lab. no. 1039).

A list of selected calciferous amphiboles has been published by the present writer,[3] and the representative point for the Tiree mineral was plotted as no. 147 in fig. 1 of that paper. The present analysis shows almost exactly two atoms of Ca, and the alkali, in which K slightly predominates over Na, fills the 'vacant space' but does not replace Ca. Silicon has been replaced by aluminium almost to the normal limit at 6Si, so that the mineral approaches the composition of hastingsite and

[1] H. von Eckermann, Geol. För. Förh. Stockholm, 1922, vol. 44, p. 354. [M.A. 1-396.]

[2] C. F. Davidson, Trans. Roy. Soc. Edinburgh, 1943, vol. 61, pp. 71–112. [M.A. 9-166.]

[3] A. F. Hallimond, Amer. Min., 1943, vol. 28, pp. 65–89. [M.A. 9-270.]

should perhaps strictly be so termed, though the mode of origin in limestone makes pargasite more convenient. A. N. Winchell[1] and N. Sundius[2] have proposed variations in the detailed nomenclature of the amphiboles. Limestone alkali-amphiboles hitherto often termed pargasite form, however, a very distinctive group (cf. figs. 1 and 2 above mentioned), and the rigorous application of such a nomenclature would set up an arbitrary division of this group with the result that the intermediate (and commonest) members could only be named with certainty with the help of a chemical analysis. For general purposes, therefore, it may be permissible to continue the use of *pargasite* for limestone amphiboles of the present class, even when the content of Al approaches that of hastingsite.

By selecting the points adjacent to no. 147 in the above-mentioned fig. 1, it is possible to collect a group of similar analyses, from which the limestone occurrences may be selected as more directly comparable. No. 152, from Mansjö (Eckermann, 1922, loc. cit.), occurs sparingly near the extremities of reacted pegmatite dikes in limestone, with scapolite, pyroxene, &c. The Mansjö pegmatite contains a good deal of iron, yet the amphibole is highly magnesian. The Mansjö pyroxenes already mentioned show a similar increase in Mg toward the limestone. Yet the limestone itself contains only 1 % MgO. The explanation would seem to be that the magnesia of the original limestone has been almost entirely taken up by the silicates, according to a typical dedolomitization reaction, leaving a calcite-rock, as will be suggested also for Tiree. No. 158, from Pargas (Laitakari, 1921, loc. cit.), is closely similar to Tiree, but, like most Pargas material, is rich in fluorine. No. 156 is from a Monte Somma bomb and no doubt represents the reaction of a limestone fragment with the lava; the analysis is incomplete.

Chlorine has rarely been recorded in an amphibole. Its presence was confirmed by a separate estimation on a sample which had not been cleaned with HCl. An outstanding example seems to be the mineral dashkesanite[3] with up to 7·24 % Cl. (F,Cl,OH) is only half the value required by the usual cell-formula, but this seems to be common in amphiboles. Here, as in some other cases, the difference cannot be attributed solely to oxidation of the iron.

[1] A. N. Winchell, Amer. Min., 1945, vol. 30, p. 27. [M.A. **9**–271.]

[2] N. Sundius, Sveriges Geol. Undersök., 1946, Årsbok 40, no. 4. [M.A. **10**–70.]

[3] G. A. Krutov, Bull. Acad. Sci. URSS, Cl. Sci. Mat. Nat., Sér. Géol., 1936, pp. 341–371. [M.A. **6**–438.]

*Biotite of the aggregate* (Lab. no. 1040).

The present writer[1] has published a diagram for 119 biotites showing the values of RO and $R_2O_3$ for $(Si,Ti)O_2 = 600$. The diagram was prepared a few years before the micas were investigated by X-ray methods, but the unit cells do in fact commonly contain about 6(Si,Ti). In any case it is a rigorous statement of the oxide ratios, and can be used at once to test the agreement of the published analyses with any proposed formulae. The component formulae required by current structural theory are those generally accepted for muscovite and phlogopite, together with a substituted phlogopite $K_2R''_5R'''_4Si_5O_{20}(OH)_4$. The last was termed eastonite by A. N. Winchell[2] who, however, calculated the iron as FeO. Eastonite is represented on the above diagram by the point $R_2O_3$ 240, RO 600, and if a triangle is completed between this point and those representing muscovite and phlogopite it will be seen that the plotted analyses are quite well grouped within this area, so that, as far as regards the oxides plotted, the deviations in composition from simple mixtures of phlogopite and muscovite are adequately expressed by introducing to a small extent the well-known substitution $Al_2/MgSi$.

On this diagram the co-ordinates of the Tiree mica will be $R_2O_3$ 160, RO 497. The point lies about half-way between phlogopite and the most acid biotites, so that in composition the mineral must evidently be classed with the biotites. It is indeed practically uniaxial, but, as S. B. Hendricks[3] has shown, these micas show complex differences in the arrangement of the layer structure, and these will no doubt involve optical variations which will render it impossible to establish a classification of biotite and phlogopite by means of the optic axial angle alone. Neighbouring analyses in the diagram are mainly iron-bearing biotites from veins, gneiss, &c., yet there is here a very high ratio of magnesia. The exceptional nature of the Tiree mineral is fully confirmed by comparison with a recent review by E. W. Heinrich.[4] That author does not discuss the relationship with alumina, which is dealt with in the above diagram, but he has prepared a series of triangles with FeO, MgO, and $Fe_2O_3+TiO_2$ as co-ordinates, on which are represented the micas derived from various rock-types. The present mica will be represented by a point near the MgO corner of the diagrams and it is at once evident that only two types of rock have yielded such micas: the 'ultrabasic'

[1] A. F. Hallimond, Min. Mag., 1926, vol. 21, p. 29.
[2] A. N. Winchell, Amer. Min., 1935, vol. 20, pp. 773–779. [M.A. 6–294.]
[3] S. B. Hendricks, ibid., 1939, vol. 24, p. 729. [M.A. 7–496.]
[4] E. W. Heinrich, Amer. Journ. Sci., 1946, vol. 244, pp. 836–848. [M.A. 10–73.]

and 'limestone' classes. All the ordinary igneous and metamorphic sources yield micas with a considerably higher content of FeO. The Tiree mica may therefore be classed as an abnormally magnesian *biotite*.

## IV. Equilibrium relations.

Analyses of amphiboles accompanied by that of the associated pyroxene or mica are not common. A few examples bearing on the present question are given in table III.

Table III. Partition of oxides between amphibole (Am.), pyroxene (Pyr.), and mica (Bi.).

| Oxide. | Tiree (147). | | | Mansjö (152). | | | Edenville (96). | | Vesuvius (156). | | Khibina.[1] | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Wt. %. | Pyr. | Am. | Bi. | Pyr. | Am. | Bi. | Pyr. | Am. | Pyr. | Am. | Pyr. | Am. |
| MgO ... | 14·8 | 14·1 | 18·7 | 17·0 | 17·8 | 26·6 | 10·0 | 11·5 | 13·7 | 16·5 | 14·1 | 14·9 |
| FeO ... | 2·8 | 6·0 | 6·8 | 4·1 | 3·2 | 0·6 | 12·8 | 13·8 | — | — | 1·9 | 1·6 |
| $Fe_2O_3$ ... | 1·8 | 3·4 | 1·1 | 0·5 | 1·5 | 2·4 | 1·3 | 3·1 | — | — | 8·7 | 7·1 |
| $Al_2O_3$ ... | 4·7 | 15·9 | 17·6 | 1·6 | 15·4 | 14·7 | 2·0 | 11·9 | 5·6 | 8·3 | 3·4 | 16·3 |
| CaO ... | 23·6 | 12·9 | 1·2 | 22·6 | 13·8 | 0·43 | 22·1 | 11·6 | 22·9 | 14·5 | 22·4 | 9·3 |

The numbers in brackets refer to the list of amphiboles (A. F. Hallimond, 1943, loc. cit.).

The Edenville amphibole is less aluminous than the others, but shows a similar partition with the pyroxene. The monchiquite minerals from Khibina tundra have been included for comparison, but the ratio $Fe_2O_3$:FeO indicates that the amphibole is basaltic. The high oxidation is reflected in the pyroxene. E. S. Larsen and others[2] have noted a similar high proportion of $Fe_2O_3$ in biotite occurring with basaltic amphibole. The Mansjö pyroxene cited was that in limestone 10 cm. from contact, not occurring directly with the amphibole and mica. The other Mansjö pyroxene is chemically much nearer to the pegmatite with which it is in direct contact.

The first three examples are typical. Their oxide ratios are in many ways consistent and seem in keeping with the view that the associated minerals were in each case approximately in equilibrium. In Khibina the low values for FeO are deceptive, being due to the oxidizing conditions, and the Mansjö mica may also have been subjected to some oxidation, for an associated phlogopite (no. V) is described as 'gold-glanzende'. Alumina enters the amphibole and mica much more freely than the pyroxene, while the other oxides appear to be fairly evenly

[1] N. P. Lupanova, Trav. Inst. Pétrogr. Acad. Sci. URSS, 1934, no. 6, pp. 53–64. [M.A. 6–420.] Phenocrysts in a monchiquite dike.

[2] E. S. Larsen, I. Irving, F. A. Gonyer, and E. S. Larsen III, Amer. Min., 1937, vol. 22, p. 895. [M.A. 7–31.]

hared, with rather more MgO in the mica. The CaO approximates to aturation in pyroxene and amphibole, and is, of course, practically bsent in the mica.

## V. General conclusions.

The Tiree diopside contains so little alumina that the groundmass narble in which it occurs must be regarded as substantially similar to he 'white marble' (cf. Coomáraswámy, 1903, loc. cit.), though apparntly without any local excess of magnesium capable of yielding rthosilicate minerals. The only important foreign constituent indicated eems to be fairly pure silica, or siliceous inclusions, scattered in a emarkably even manner throughout the rock.

In the gneiss-like aggregate the abnormally high magnesia points o a free reaction with the limestone, which has been dedolomitized. Evidently, however, the other oxides, particularly the alumina, must here be derived almost entirely from the original rock-fragment which was metamorphosed to form the aggregate. The amphibole is fully alkaline and there is a further amount of potassium in the mica, so that the quantity of alkali would agree with an orthogneiss (or its unaltered equivalent) as a possible original material of the inclusion. On the other hand, the possibility of derivation of the aggregates from an alkaline sediment such as that of Harris (C. F. Davidson, 1943, loc. cit.) may require consideration. When allowance is made for the changes due to crushing, the introduction of chalcedony, and the alteration of the scapolite, the marble seems to be essentially a metamorphic limestone of an intermediate grade. During the metamorphism a free chemical readjustment took place, not only by transfer of MgO and of $CaCO_3$ to the silicates by dedolomitization with scapolitization, but also by a local movement of the 'volatiles' leading to alternative growth or recession of pargasite, mica, and fassaite. These changes seem to be proceeding simultaneously in different places even in the same rock section. The reaction is particularly characterized by extended intergrowths of pargasite and mica, which tend to obliterate the normal equilibrium 'pflaster' structure. Whether the latter was already present in the original fragment or was only developed during the last metamorphism may be difficult to decide. The present evidence seems clear, on chemical as well as mineralogical grounds, that a general metamorphism accompanied the dedolomitization, leaving the silicate minerals in local chemical and textural equilibrium with the groundmass of coarse calcite.

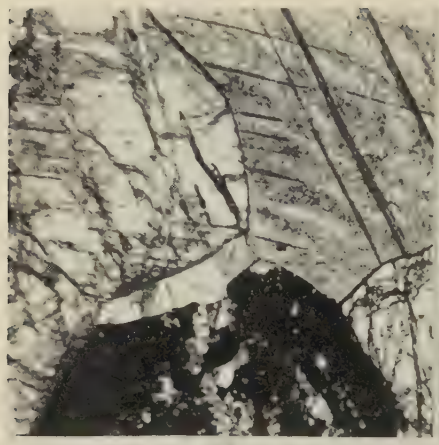
In the distribution of the oxides between minerals and limestone, and texturally, as, for example, in the intergrowth of mica and pargasite, there is a strong resemblance to the Mansjö occurrence. At that locality various highly magnesian silicates also occur at the contact of an iron-bearing acid igneous rock and a calcite-marble. The close analogy with the Tiree marble would seem to indicate that the Mansjö minerals have gained their magnesium from the limestone by a metamorphic reaction after emplacement of the pegmatite, rather than by progressive modification of the pegmatite during injection. The series of pegmatite analyses given by Eckermann (1922, loc. cit., p. 326) support the view there expressed that potassium has migrated from the pegmatite and has been precipitated as phlogopite near the contacts. On the other hand, there seems no similar evidence for the migration of the very small amounts of magnesia shown in the analyses: the limestone seems the most probable source of this constituent, which, like the potassium, has been precipitated as insoluble silicates at the contact.

The Mansjö pargasite-mica intergrowths lie in calcite at the centre of thin apophyses of the pegmatite, so that they resemble a late liquid residue. Since the formation of the silicates yields free $CO_2$, it is always possible that a small development of carbonate liquid may have taken place, with the formation of calcite veins of very local significance. In other cases there may be only a weakening of the limestone at the time of reaction. It has been shown that calcite is more easily deformed under such conditions even when far below the melting-point.

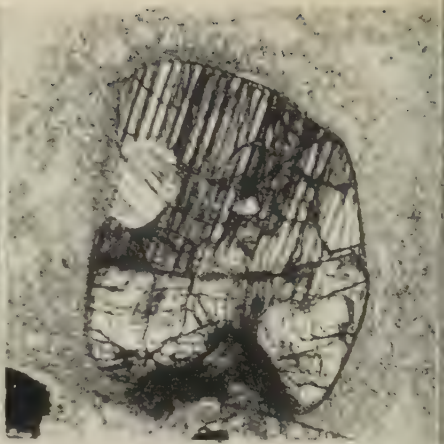
The most remarkable feature of the Tiree marble is the extensive distribution of the foreign rock-fragments. The present investigation seems to establish their emplacement before the latest metamorphism, but little additional information has been gained as to the original mode of emplacement. A small proportion of other rocks such as pegmatite are also present, and this basic aspect of the problem might perhaps be decided by a general survey of the nature and distribution of the 'xenoliths', with allowance for metamorphic changes of the kind indicated in the present paper, operating on what was originally a dolomitic limestone of a type that is widely distributed in the Lewisian rocks.

*Note on the dilution of methylene iodide with aniline.*

Volatile solvents have commonly been employed to lower the constants of methylene iodide in mixtures used for work on densities and refractive indices. They have the disadvantage of requiring distillation or freezing



1



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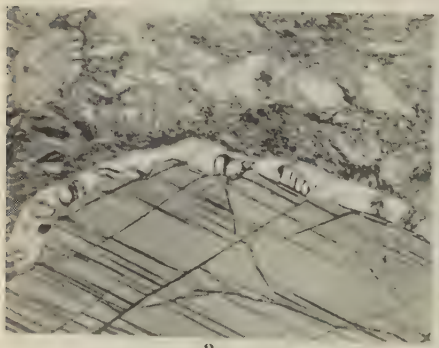

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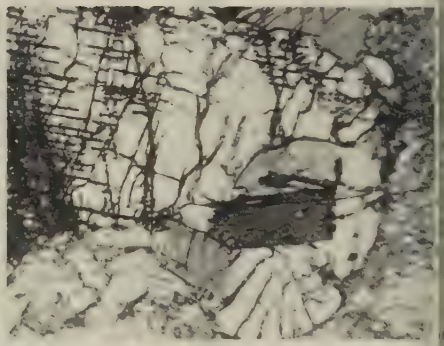

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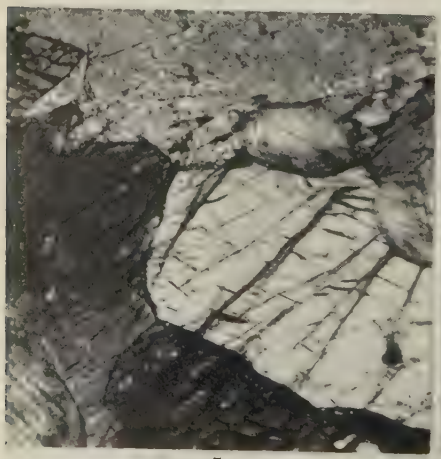
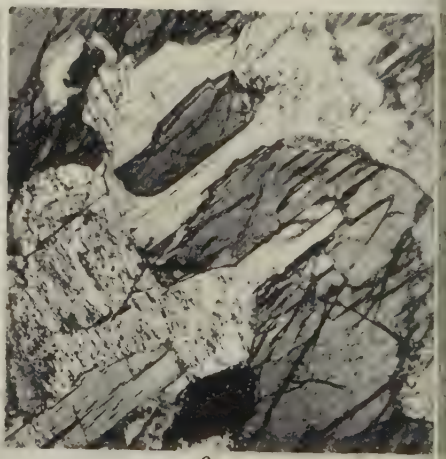


5



6

A. F. HALLIMOND: PYROXENE, ETC., IN TIREE MARBLE.

to recover the iodide, and an alternative was sought in the course of the work on the Tiree minerals. Aniline as a diluent seems to fulfil all the requirements fairly well. It is only moderately volatile, and can be removed from the methylene iodide by washing the liquid in a separating funnel with dilute hydrochloric acid. This forms water-soluble aniline hydrochloride, while practically pure iodide sinks and can be drawn off. The iodide so obtained contains a little hydrochloric acid, which is removed by washing with weak ammonia, after which the iodide is dried by contact with fused calcium chloride. A sample recovered in this way in 1938 was found to be in good condition after nine years, with normal refractive index, though wine-coloured; it cleared well on standing with a piece of copper wire.

*Note.*—Since this paper was read, a review of the biotites from igneous rocks has been published by S. R. Nockolds (Amer. Journ. Sci., 1947, vol. 245, pp. 401–420). Only five of the 77 micas there listed have a ratio (total) FeO:MgO as low as that from Tiree, so that the conclusion already drawn is confirmed. Nockolds's diagrams indicate a strong tendency for hornblende (in igneous rocks) to occur only with the less magnesian biotites. The Tiree paragenesis stands in marked contrast with this relation, since hornblende occurs closely intergrown with a highly magnesian biotite. Furthermore, Nockolds indicates a well-marked upper limit to the alumina ratio of the igneous biotites that occur with hornblende, diopside, or olivine; the Tiree mica again seems exceptional in having an alumina ratio somewhat above this limit. These peculiarities tend to confirm the view already expressed that the Tiree aggregate was formed by chemical alteration at a lower temperature, and not directly from fusion, though the original material may well have been a fragment of orthogneiss.

## Explanation of Plate XIV.

Figs. 1 and 2, Microstructure of groundmass of Tiree marble. Figs. 3–6, Microstructure of aggregate from Tiree marble.

The numbers refer to slides and photographs in the Geological Survey Collection.

Fig. 1. Pyroxene, polyhedral grains with fissures containing calcite and chalcedony. One large grain of strain-twinned calcite. Crossed polarizers. S32453. M2300. ×27.

Fig. 2. Pyroxene, twinned ‖ *a*, with an embayment of coarse twinned calcite, in crushed calcite. Crossed polarizers. S32453. M2302. ×27.

Fig. 3. Amphibole with envelope of altered scapolite containing grains of pyroxene, in crushed calcite. Small idiomorphic amphibole with a partial envelope, in calcite. Polarized light. S32451. M2299. ×27.

Fig. 4. Pyroxene with dark inclusions, also small grains of amphibole and mica, in partly crushed calcite. Polarized light. S32451. M2298. ×27.

Fig. 5. Polyhedral aggregate of altered scapolite (top), amphibole (middle), two rounded grains of calcite (middle, right), pyroxene (bottom, dark), with strained calcite (bottom, left). Crossed polarizers. S32451. M2297. ×27.

Fig. 6. Parallel intergrowth of mica and amphibole, with altered scapolite. Crossed polarizers. S32451. M2301. ×27.

# *Note on the occurrence of anatase in some fireclay deposits.*

By G. W. Brindley, M.Sc., Ph.D., Reader in X-ray Physics,
and Keith Robinson, Ph.D., Research Assistant,
Physics Laboratories, University of Leeds.

[Read November 6, 1947.]

In X-ray studies of fireclays we have frequently observed the presence of anatase to the extent of 1 or 2 % with little or no rutile, and no brookite. Chemical analyses of these clays usually record 1–2 % of $TiO_2$ and occasionally more (Ennos and Scott, 1924). The mineralogical form of the $TiO_2$ is usually not stated, but a number of references to the observance of rutile needles give the impression that rutile is the form in which titania occurs in these deposits. Our own observations based on X-ray powder photographs lead us to conclude that anatase is commonly present and that rutile is either absent or present in smaller quantities. We have not detected brookite.

The presence of anatase in fireclays is easily revealed by X-ray powder photographs when a camera of adequate resolving power is employed (e.g. a 20-cm. diameter camera used with Cu-$K\alpha$ radiation). The strongest anatase line at 3·51 Å. is adjacent to the second-order basal reflection from the kaolin mineral in the fireclay at about 3·57–3·60 Å. Other anatase lines are weaker and may be overlooked or may be masked by reflections from other minerals present. X-ray photographs of artificially prepared kaolinite-anatase mixtures show that as little as 1 % of the latter mineral may be detected. Its presence is more definitely shown by heating the clay to 600° C. for 15–30 minutes when the kaolinite structure breaks down and the anatase lines are then more easily seen. In all cases where we have used this method we have found the full powder diagram of anatase. Anatase does not change to rutile unless heated to 800° C. or higher temperatures, depending on its mode of preparation (Pamfilov and Ivancheva, 1940; Thienchi, 1946). Some chlorites also give a line at about 3·5 Å., but they are usually revealed by a 14 Å. line and by a line at about 4·6 Å. of comparable intensity to the 3·5 Å. line. There should be no difficulty in distinguishing anatase

from a possible chlorite. In the majority of fireclays which we have examined, anatase is still present when fine fractions approaching 1 $\mu$ in size are separated by sedimentation methods; in fact the anatase appears to be of comparable fineness to the kaolin mineral in the fireclay.

It would be out of place here to give a wide survey of references to the mineralogical form of titania in kaolin clays, but the following may be briefly mentioned; Ennos and Scott (1924) in their memoir (p. 4) record nineteen accessory minerals in clays including rutile but not anatase, and in a discussion of titania in clays state (p. 9), 'It generally occurs as microscopic or sub-microscopic crystals of rutile ($TiO_2$) or ilmenite ($FeTiO_3$).' Coon and Lewis (1926) discussing accessory minerals in pottery china-clays mention 'minute acicular crystals whose identification is ambiguous, probably rutile', but anatase is not mentioned. Gregory (1910) examined fireclays from Ayrshire and found 'abundant excessively small needles and granules of rutile', but he also did not record anatase. In a memoir on 'The Ayrshire bauxitic clay', Wilson (1922) states (p. 12) that 'small grains of rutile can readily be recognized' and that 'clusters of minute crystals . . . can be seen' which may be 'rutile, anatase and sphene'. De Lapparent (1934) has also examined the Ayrshire bauxitic clays; discussing the decomposition of ilmenite, which has come from basaltic fragments in the clay, he writes (p. 3), 'In the last stage of decomposition the titaniferous iron oxide has yielded anatase, which may be said to be the characteristic form which titanium oxide possesses in the bauxitic clays.' This is the only clear statement we have found in the literature that anatase rather than rutile is the normal form in which titania exists in fireclay deposits.

The clays we have examined fall into four groups.

I. *Fireclays from Ayrshire and Central Scotland.*—An Ayrshire bauxitic clay (exact locality unknown) has been examined together with the following six clays from Central Scotland: the blue clay at Glenboig, the clay immediately beneath it, and the black clay at Castlecary, all of which are part of the Upper Clay Seam of the Millstone Grit Series; samples of the Lower Clay Seam from Glenboig and Levenseat; and lastly the so-called 'cement clay' immediately underlying the cement stone horizon. In all these clays, X-ray photographs have shown the presence of anatase to the extent of 1–2 %. Chemical analyses have shown between 1 and 2 % of $TiO_2$, so that these amounts are probably wholly or largely anatase. These results provide direct confirmation of de Lapparent's results.

II. *Fireclays from the Carboniferous Coal Measures, mainly in Yorkshire.*—Fireclays from Halifax, Elland, Gildersome, Denholme, Tong, Ambler Thorn, Queensbury, and Ingleton in Yorkshire, and from Knowlbury in Shropshire have been examined and without exception all appear to contain anatase to the extent of about 1 %, although the quantity varies somewhat from one specimen to another. The conclusion may be drawn that in clays of this type anatase is commonly present; furthermore, sedimentation tests have shown that it is of comparable fineness to the kaolin mineral.

The following observations of Butterfield (1934, 1936) on the occurrence of anatase in sandstones of the Millstone Grit Series in Yorkshire may be noted: he writes (1936, p. 150), 'As a source of titanium minerals in the Grit ilmenite is a mineral to suspect . . . ilmenite has come into the Grits in large quantities. In many cases it is still found in fair abundance as fresh rounded grains, but more often it shows traces of alteration. . . . All stages in this alteration process can be followed from the partial alteration to complete replacement by leucoxene, and then further to the formation of tablets of anatase.' It seems not unlikely that a similar process may be responsible for the presence of anatase in the overlying Coal Measure fireclays.

III. Kaolinites from various sources throughout the world have been examined and in no case have we detected either anatase or rutile.

IV. Among miscellaneous clays, dickite may be included; neither anatase nor rutile has been detected in association with this mineral.

Finally, we wish to tender our thanks to all who have supplied us with specimens of clays and especially to Dr. F. A. Bannister for many kaolinites, to Professor A. L. Roberts for many Yorkshire fireclays, to Dr. J. E. Hemingway for kaolinites, dickites, and other clays, to Mr. J. McWilliam for the Central Scottish clays, and to Mr. A. T. Green, Director of the British Refractories Research Association, and Mr. A. E. Dodd of that Association for specimens of clays and for a memorandum on the occurrence of $TiO_2$ in clays. We also tender our thanks to the Department of Scientific and Industrial Research for a grant to assist a programme of research on clay mineralogy.

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## *Excursion to Penrith and the north-west.*

Report by the Directors,

K. C. Dunham, D.Sc., S.D., and S. E. Hollingworth, M.A., D.Sc.

MINERAL localities in north-western England were visited during the second excursion organized by the Society in recent years, from April 14 to 18, 1947, the headquarters being the George Hotel, Penrith. Members taking part included: The President, W. Campbell Smith (London), O. J. Adamson (Oslo, Norway), W. Anderson (Newcastle), F. A. Bannister (London), D. W. Bishopp (Dublin), C. E. N. Bromehead (London), G. F. Claringbull (London), T. Deans (London), W. A. Deer (Cambridge), K. C. Dunham (London), N. R. Goodman (Nova Scotia and Oxford), G. S. Gowing (Stockton-on-Tees), S. E. Hollingworth (London), W. Hugill (Stoke-on-Trent), H. Neumann (Oslo and Leeds), C.W. Pegg (London), F. H. Rathmann (U.S.A.), P. L. Rumsby (London), R. D. S. Shrimpton (Slough), J. H. Taylor (London), E. A. Vincent (Durham), L. R. Wager (Durham), Miss D. E. Wisden (Southampton). Dr. Claringbull undertook the administrative arrangements.

Tuesday April 15 was devoted to a visit to the Florence mine of the Millom and Askam Haematite Iron Co. Ltd., through the courtesy of Major Arthur Hibbert, D.S.O., M.C. The journey to Egremont took the party through the northern part of the Lake District, by Keswick, Bassenthwaite Lake, and Cockermouth. Dr. F. M. Trotter met the party at the mine, and explained the geological background of the West Cumberland haematite deposits, which include fault-veins and replacement ore-bodies in the Carboniferous Limestone, found where that formation is, or was formerly, directly overlain by Brockram and St. Bees Sandstone of Permo-Triassic age. Where St. Bees shale intervenes between Brockram and Limestone, ore-bodies are rarely found. Dr. Trotter mentioned the rival hypotheses of origin of these deposits[1] and pointed out: (1) that they are definitely of post-Triassic age, for haematite and associated minerals have been found by borings in the Brockram, and the mineralized faults cut Permo-Triassic strata; (2) that in addition to haematite, the deposits carry a magnetic form of specularite and small amounts of chalcopyrite, pyrite, manganite, galena,

[1] The origin of Cumberland haematite. (1) by E. E. L. Dixon; (2) by Bernard Smith. Summ. Progr. Geol. Surv., 1928, for 1927, pp. 23–36.

baryte, and fluorite. The mineral assemblage and the restriction of the mineralization to the Brockram and the limestone adjacent to it indicate solutions of magmatic origin which reached the limestone by flowing down-dip through the Brockram.[1]

Dr. G. A. Schnellmann, after explaining the geology of the mine, then conducted the party down Florence shaft and round the workings, where a thick replacement ore-body related to the north-north-west Florence fault was examined. Good cavities containing kidney haematite, specularite, dolomite, and pale blue fluorite were found. The edge of the ore-body where it dies out against limestone was also seen.

Little was seen of the west coast owing to unfavourable weather, but the sun broke through during the return journey to Penrith, and a visit was made to Lake Ullswater and to Aira Force for tea.

On Wednesday April 16, the Mungrisdale area was visited. Leaving the bus a short distance south of the fell road ford over Carrock Beck 4 miles north of Mungrisdale, the party headed west up the northern side of the Carrock Beck valley towards the outcrop workings on the Sandbeds–Driggith vein. This vein, which is believed to be the north-eastward continuation of the southern member of the Roughton Gill veins,[2] has been worked from levels on the northern (Sandbeds) side of the high ground and from the southern side (Driggith mine). Opencast workings and collapsed stopes at 1500–1600 feet O.D. show a lode up to 12 feet wide in intensely rotted Borrowdale volcanic rocks. Quartz, with massive ribs of baryte up to 2 feet wide, predominates, with lenses of decomposed country-rock. The galena and blende with some chalcopyrite tended to be concentrated in the central part of the lode. Good specimens of pyromorphite as small crystals on joint faces and as massive radiating needle-like growths were obtained.

Thick mist and a cold wind hindered observation and collecting at this stage, and with an intermediate pause for an early lunch the party moved south across heather-covered moorland to the north side of the Drygill valley, south-south-east of High Pike. Here orange and green barrel-shaped crystals of campylite occur in the mineralized east–west quartz vein which forms a prominent feature at the top of the valley side. The vein occurs on the major fault which separates the Drygill Shales on the south from the Borrowdale Volcanic Series on the north.

[1] F. M. Trotter, *in* The geology of Gosforth. Mem. Geol. Surv., 1937, pp. 64–75; and The origin of the West Cumberland haematites. Geol. Mag., 1945, vol. 82, pp. 67–80. [M.A. **9**–236.]

[2] T. Eastwood, The lead and zinc ores of the Lake District. Spec. Rep. Min. Res., Mem. Geol. Surv., 1921, vol. 25, p. 42.

Good specimens were obtained from exposures of the vein and from dumps of old adits driven from the stream bed.

The sun was breaking through as the party walked southward across the moorland to the head of Brandy Gill where pyrolusite-bearing quartz strings in rotted diabase were noticed, and a short halt was made at the old dumps, half-way down Brandy Gill, from which wulfenite has been obtained from time to time.

The main objective was then the Carrock wolfram mine near the junction of Brandy Gill and Grainsgill Beck. This mine has a history of intermittent working since the 1860's. Considerable development work was done in 1941–44 by the Non-Ferrous Minerals Development Control (Ministry of Supply) and useful reserves of tungsten were proved. The mine was visited by kind permission of Mr. Anthony Wilson, M.I.M.M., the present lessee.

Wolframite, associated with scheelite, arsenopyrite, and subordinate amounts of molybdenite, occurs in a series of north–south quartz veins ranging from a few inches to 4 feet wide which are strongly developed in the greisenized granite of Grainsgill and pass northward through a narrow belt of Skiddaw Slates into the gabbro complex of Carrock Fell.

The party divided, some examining the old main level on the Harding vein and others the new low-level cross-cut. Excellent cross-sections of the vein were visible in the clean roof of the recently driven headings, and many fine bunches of wolframite with associated scheelite, ankerite, and occasional large prisms of apatite were seen. Active collecting was also carried out on the dumps.

The bus awaited the party in the Caldew valley above Swineside and after an excellent tea at Mungrisdale and a brief visit to the small quarry in Skiddaw Slates behind the school the return journey to Penrith was made.

After dinner a visit to the mineralogical collection in the Penrith Museum, kindly arranged by Dr. F. H. Day, was made by some members of the party, and the interesting collection of Mr. W. F. Davidson was also inspected.

On Thursday April 17, Silverband baryte mine and mill in Westmorland were visited at the invitation of B. Laporte & Co. (Luton). The party was met at the mill (fig. 1), situated at the foot of the western escarpment of the Pennines near Milburn Grange, by Mr. B. E. A. Vigers, Mr. Geoffrey Hickson, and Mr. W. S. Lancaster (directors of the company), Mr. Alexander Reid (consulting engineer), and Mr. Thompson

Lancaster (manager). After looking round the mill, a modern gravity plant, the 4-mile ascent of the escarpment was made in perfect weather by way of the spectacular mine-road which follows Knock Ore Gill, in a lorry provided by the company. The mine, at 2400 feet O.D., was then visited. The principal geological structure here is the east–west Dun Fell fault, downthrowing north 120–140 feet.[1] From this fault

Fig. 1. Group at Silverband baryte mill, Westmorland.
W. S. Lancaster, J. H. Taylor, N. R. Goodman, D. W. Bishopp, T. Deans, R. D. S. Shrimpton, C. E. N. Bromehead, H. Neumann, F. A. Bannister, Thompson Lancaster, W. Hugill, — Smith, G. Hickson, P. L. Rumsby, G. F. Claringbull, E. A. Vincent, C. W. Pegg, S. E. Hollingworth, Alexander Reid, G. A. Schnellmann, W. A. Deer, O. J. Adamson, W. Anderson, K. C. Dunham, W. Campbell Smith, F. H. Rathmann, Miss D. E. Wisden, G. S. Gowing, Mrs. Thompson Lancaster, L. R. Wager. (Photo. G. F. Claringbull.)

a number of smaller faults fly off on the downthrow side, diverging at a small angle at first, then turning north-eastward. These and the main fault are mineralized in the Great Limestone (Lower Carboniferous) with baryte, and smaller amounts of galena. Those portions productive of galena were worked by the London Lead Co. during the early years of the 19th century. The main production of the mine now comes from a large replacement ore-body, lying between the faults

[1] K. C. Dunham and H. G. Dines, Barium minerals in England and Wales. Geol. Surv., 1945, Wartime Pamphlet no. 46, pp. 37–41.

at the horizon of the Great Limestone. This carries baryte crystals, often water-clear, up to 2 feet long, in a matrix of clay and unreplaced limestone. The clay is probably of residual origin, and may have derived its iron-content from ankerite, pseudomorphs after which, in limonite, are found in association with the baryte. Fluorite has been found only in the deepest workings of this mine, at the horizon of the Four Fathom Limestone, reached by means of an underground shaft on the Slope vein. Narrow but laterally extensive post-mineralization caverns, developed along north-north-west joints in the limestone, and also along the north-east veins, were examined, and the ease with which the London Lead Co. had been able to convert these into useful exploratory cross-cuts was noted.

In the evening the Company entertained the Society to dinner at the King's Head Hotel, Appleby, with Mr. B. E. A. Vigers in the chair. In expressing the gratitude of members of the excursion to Messrs. Laporte, Dr. Dunham announced that he had sent a telegram of thanks to the chairman of the Company, Mr. L. P. O'Brien; and he paid tribute to the directors and staff, who had given every possible encouragement during his investigation of the geology and mineralogy of the mine for H.M. Geological Survey and had now most generously entertained the large party of visitors. The evening concluded with speeches and music.

On the last day of the excursion, the gypsum mines of Thos. McGhie & Sons Ltd. in the Kirkby Thore-Long Marton area were visited during the morning by kind permission of the resident manager, Mr. K. Boazman.

Gypsum occurs at three main horizons in the 500 feet of red and grey shales and marls that lie between the Permian Penrith Sandstone below and the Triassic St. Bees Sandstone above.[1]

The lithological characters of the 'B' bed in the middle of the shale-marl sequence were first examined in the disused and partially flooded McGhie's quarry. The distinctive 'porphyritic' selenite occurring as scattered crystals or concentrated in certain bands in a fine-grained granular gypsum matrix was noted as a feature which is found to persist at depth, where the fine-grained mass of the rock is present as anhydrite. After a brief visit to the nearby mill to see the 'boiling' of the finely powdered gypsum during calcination in the kettles, the party proceeded to New Stamp Hill mine a mile south of the mill where they were welcomed by Mr. Boazman and the mine manager, Mr. W. Hunter.

[1] S. E. Hollingworth, *in* Gypsum and anhydrite. Spec. Rep. Min. Res., Mem. Geol. Surv., 3rd edit., 1938, vol. 3, pp. 12–13.

Here the thick 'A' seam at the base of the shale-marl group is mined pillar-and-stall with galleries reaching 25–30 feet in height. One of the principal lithological characters of this seam is the abundance of 'satin spar' bands along bedding planes. Each band is bordered above and below by a thin film of grey shale which is perhaps due to segregation of argillaceous material on recrystallization of massive somewhat marly gypsum to the fibrous form. The 'Daisy bed', a 5-inch band made up

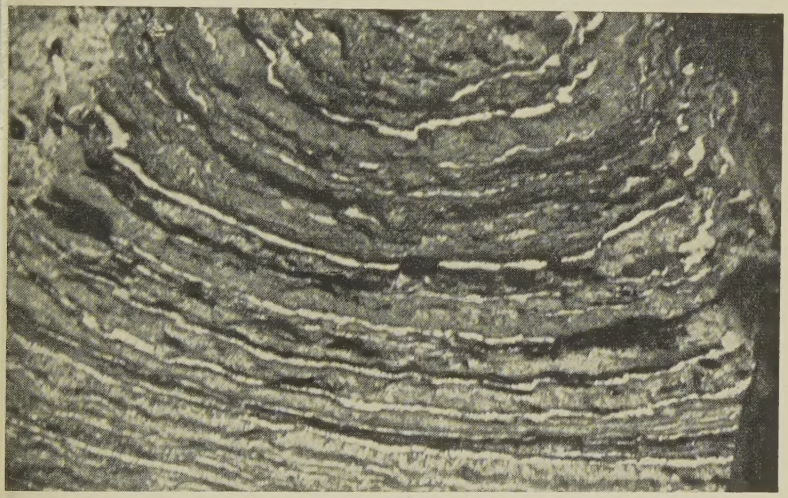

Fig. 2. View of part of roof and wall of natural cavern formed by solution in banded gypsum ('A' bed), New Stamp Hill mine, Kirkby Thore. (Photo. E. A. Vincent.)

of a contorted layer of orange-pink selenite spherulites each $1\frac{1}{4}$ inch diameter, attracted much attention among collectors.

Before leaving the mine a large natural cavern formed by solution of the gypsum was entered (fig. 2). It is 20 feet high, and of beehive form and shows the effects of differential solution of the gypsum beds. It is a unique occurrence in this country and the suggestion that every effort should be made to preserve it from destruction by mining was sympathetically received by the company's officials.

It was found that time allowed a hurried visit to the Birks mine a mile to the east. Here the 'B' bed, considerably disturbed by a series of sharp folds, is exploited from an inclined adit. The main haulage way crosses a series of folds so that shale below the 'B' bed and the shales above are alternately exposed. In the keels of the synclines sharp

infolds of the 'C' bed 10–14 feet above the 'B' bed were also examined. Since the abandonment of the Acorn Bank mine these are the only accessible exposures of the 'C' seam.

In the deeper part of the mine the progressive increase in the thickness of anhydrite at the expense of the gypsum was studied in detail. Before leaving Birks mine, Dr. Campbell Smith expressed the thanks of the Society to the owners and to Mr. Boazman and Mr. Hunter for facilitating the visit to the gypsum workings.

In the afternoon the bus was taken to Hilton and (by skilful driving) up the Scordale valley to visit, by permission of Mr. W. Wharton, the old Hilton and Murton lead mines, famous for their amber fluorite. Here flat replacement deposits at the top of the Melmerby Scar Limestone, beneath the Whin Sill, were formerly worked for lead by the London Lead Co., and have more recently furnished baryte and a little witherite. Typical examples were seen in Dowscar high level; here the deposits vary up to 6 feet thick and consist of amber fluorite, galena, and coarse baryte. Good crystals of amber fluorite were obtained from clay-filled cavities.